THE
ELECTRICAL REVIEW.

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THE ELECTRICAL CONTRACTORS' ASSOCIATION v. THE L.C.C.

"Contractors in the electrical world, as contractors elsewhere, are doing wrong to themselves and hence wrong to municipalities when they suggest that the field of work which we are taking in hand for the good of the community is injuring them."

THIS extraordinary statement was made by Mr. G. L. Gomme, Clerk to the London County Council, in the course of his reply to the toast of "The Council and Municipalities" at the recent dinner of the Electrical Contractors' Association.

Coming from one who holds such an important position, who knows and probably influences the mind and policy of the Council, such a remark cannot be treated with the derision it merits. The subject matter is one which so vitally affects electrical contractors, and consequently manufacturers—as the two sections are mutually interdependent—that it is necessary to treat seriously such an observation as that quoted above, however intrinsically nonsensical and absurd it may seem.

It is interesting to note the course of reasoning adopted in order to arrive at so astounding a conclusion. Mr. Gomme's reasons are given in the form of a confession of faith as follows:—

"I am one of those who believe that extending work in any direction is extending trade. I cannot help thinking that if you are hurt in one direction the development of industry will come about by which you will gain in another direction . . . . One is also confronted with the fact that electrical work is still in its infancy . . . . I cannot help feeling that in the new field for electrical enterprise there is ample scope for everyone, and it is rather unwise that this great body at the table should be looking at the past instead of at the future."

Mr. Gomme then went on to say that "electric lighting is one of the great elements of good health in a city like ours, and the more that can be spread, the more we can bring that home to every household, and make them understand that electricity means better health for the community, the better it will be." As the L.C.C. looks upon the spread of electric lighting as a means of improving the health of the city, what is more natural than that it should regard electric wiring as a necessary part of the work of the sanitary department!

It is perfectly true that the spread of electric light means better health for the community; so also does good food; we may expect, therefore, before long to see municipal provision stores set up in competition with private enterprise in food supply. And why stop at food when there are so many other things which might be altered to the general advantage of the community?

"Electrical work is still in its infancy," says Mr. Gomme; and he proposes so to stimulate electrical progress, by means of municipal competition, that there will be more work for all those engaged in electrical pursuits. But why, then, stop at electrical contracting? Why not go in for electrical manufacturing, consulting, and every other conceivable branch of the electrical profession? As, surely, the arguments

which hold good for one branch of the industry are equally applicable to all the others.

Sufficient, however, unto the day is the evil thereof; and what we are concerned with more particularly just now is Mr. Gomme's proposal that the L.C.C. shall compete with contractors for electric wiring work. Feeling, perhaps, that the arguments already used were "a little too thin," he proceeded to make the excuse that this work was forced upon the municipality by contractors who, instead of making it their one object to put in good work and carry it out in a workmanlike manner, had chosen to "extract every possible penny that they can out of their working." Here, again, we would ask, why pitch on electrical contracting particularly? Surely this criticism might be levelled against the undesirables in every trade or profession, not even excepting the officers of important municipalities. The case of the Holborn town clerk is too fresh in the minds of the public to necessitate our referring further to it; we simply quote it in order to show that all trades or professions may be tarred with the same brush, and to emphasise the hollowness of the excuse given by the L.C.C. for meddling with work which is entirely outside its sphere.

Assuming, for the moment, that some electrical contractors put in bad work, and that others are incompetent, what guarantee have we that such work could or would be carried out better by municipalities?

The Mayor of Shoreditch, speaking at the same gathering, showed what a mistake it was for municipalities to embark in any such enterprise as this, and referred to the experience in his borough, where municipal wiring had had to be abandoned. It is a fact that at Shoreditch the work put into the Mayor's own premises by the municipal wiremen—and, of course, only the very best hands would be employed on the Mayor's own premises—was so bad that a fire resulted! Referring to this, Mr. W. R. Rawlings, the ex-President of the Electrical Contractors' Association, humorously suggested that if this was the way in which municipal bodies carried out contracting work, he could quite understand Mr. Gomme's contention that municipal enterprise in this direction was all for the benefit of the Contractors' Association.

In taking up electrical wiring, the municipality must first of all show that it does not intend to make any profit, for, if it do, such profit must either be devoted to relieving the rates of the general body of ratepayers at the expense of the rate-paying electrical contractors, or must be refunded to the residents whose premises have been wired. This admission at once lays the Council open to the accusation of unfair competition, as, if contracting work is to be carried out by municipalities at cost price, they must be in a position to undercut other contractors who are making, or at any rate trying to make, their living out of such work.

Nor should it be overlooked that these very contractors, whilst endeavouring to get work in competition with the municipalities, are at the same time financing the latter and providing them with the funds to carry on competitive and undercutting work. They are, in fact, making swords for their own slaying. As we have pointed out before, the profits on electric wiring are now cut so fine that to make it pay at all necessitates very efficient and economical management; and it is very probable that if the L.C.C. succeeded in obtaining wiring contracts at competitive prices, not only would it not be able to make a profit, but it might lose pretty considerably on the work, the loss being made up out of the general rates.

The question, therefore, touches not only electrical contractors and manufacturers, but also the general body of ratepayers, who, if this proposal goes through, will undoubtedly have to bear part of the cost of wiring other ratepayers' houses, whilst at the same time helping to crush out fellow tradesmen, some of whom may be their own customers. The solicitors of the Electrical Contractors' Association have been instructed to oppose the L.C.C. Bill in the House of Lords, and it is to be hoped that the whole trade will rally to the support of the Association in resisting this most objectionable form of municipal trading.

The Proposed College for Applied Science.

The preliminary report of the Departmental Committee on the Royal College of Science and Royal School of Mines has formed one of the most interesting topics of discussion during the past week. It remains to be seen whether the Committee's suggestions will take permanent shape and confer the benefits of science upon future generations. Perhaps the most hopeful characteristic of the report is that the scheme will lend itself to consideration upon Imperial lines. Its least acceptable characteristic is the negative one that there is no clear indication of what is to be effected by the fusion of the schools, and, unless London County Council scholars are to be admitted on special terms, no case appears to be made out in justification of the proposal to ask for an annual grant from the London County Council. If we seem to run against the proposal, it is not that we desire in the least degree to check the dissemination of science and scientific methods amongst the millions of untaught throughout the Empire; but we have not forgotten the Imperial Institute, and we hope to see the main details of the scheme submitted to adequate criticism, and analysed by competent authorities, before it takes actual shape.

The question is: What is the most effective means of imparting scientific principles and quantitative methods of an order sufficiently advanced to enable the problems of comfort and industry to be understood and pursued, more especially by British subjects? We are slow to believe that the answer lies in the unification of our technical colleges, supported by voluntary contributions. This may be the obvious answer, but we confess that it does not convey the impression of being the proper one. It is conceivable, as an extreme case, that if Oxford were to be co-ordinated with Cambridge, Edinburgh and Dublin, if Eton, Harrow, Rugby and Clifton were brought into line, if the Royal Society rubbed shoulders with the Society of Arts, and if the Society of Arts osculated with the London Institution, economies could be effected both of time and means. But they would lose in point of character; their work would tend towards a stereotyped form, and in the limit there would be subversion of originality, and we should be led to confess that economy was no recompense for sterility.

What is it that we want? We require an organisation for the training of technical professional men of various kinds, the training of science masters, and their distribution where they can be properly paid, and we are anxious to encourage scientific research. These requirements are not necessarily satisfied by the same conditions. Possibly a moderate degree of unification would assist matters by setting up a standard of what teachers ought to know, and imparting it to them, but we are strongly of opinion that professional studies and research work are best encouraged by fostering the differences that constitute the individualities of every college, every laboratory, every workshop throughout the country. Nature has always bestowed her gifts according to a plan which seems arbitrary, and it is scarcely to be expected that she will make an exception, even of South Kensington. Where co-ordination is desirable, and where expenditure is, it seems to us, most properly applied, is in assisting bright scholars, of restricted means, to enter the more advanced colleges, and in giving them the chance to acquire not only science but the "humanities." If the proposed scheme could be shown to fall in with that great purpose, and to be essential to it, every objection would disappear. The danger is that a

stupendous institution may be brought into existence for the training of men so much of one type that their market value will fall to a point even below that of men who are to be obtained to-day for research work.

Improving Gas-Engine Efficiency.

Were gas-power engineers more accustomed to work out indicator diagrams from the basis of the absolute vacuum instead of from the atmospheric line, it is probable that better results might be secured. Another road that might lead to economy would be the practice of taking diagrams with a weak spring and a stop on the movement of the piston, in order to obtain a clear picture of the processes inside the cylinder within, say, 15 lb. of the atmospheric line. As a rule, with a diagram scale suitable for pressures of 300, or even 500, lb. per square inch, the scale is so minute that nothing can be read off clearly up to more than 20 lb. above the atmosphere. The line drawn by the blunted style may very easily cover a breadth of 10 lb. pressure.

A thermometer in the exhaust pipe close to the engine will greatly help to a clear idea of some of the losses of a gas engine. The ordinary atmospheric or intake temperature is 520° F. absolute. Let us suppose, for convenience of calculation, that the exhaust temperature is 1,040° F. absolute (547° F.). The volume of the exhaust will then be practically double the volume of the intake. That is to say, for each cubic foot of cylinder capacity there will be 2 cb. ft. of exhaust volume, or 1 cb. ft. of gas in excess of the intake volume must be forced into the atmosphere. The atmospheric pressure is 2,117 lb. per sq. ft., or the work done in forcing 1 cb. ft. into the atmosphere is 2,117 ft.-lb. At the ordinary speed of 80 explosive strokes per minute, there will be 161,344 ft.-lb. of energy thus wasted per minute, or nearly 5 H.P.

Now, a gas engine of 1 cb. ft. cylinder-stroke volume, if it secured a mean pressure of 60 lb., would generate nearly 21 H.P. If the same engine could be made to exhaust into, or, rather, through, a large ice-cold surface condenser, it would generate 25 to 26 H.P. The steam engine secures an economy from condensing, not because the condenser and air pump remove the atmospheric pressure, for they do not. The final exhaust of the steam engine is pushed into the atmosphere, but it is not pushed in until it has shrunk to a small volume; usually it has shrunk to liquid volume, and it does not require to displace a large volume of the atmosphere. In the gas engine there is no intentional condenser. Long exhaust pipes have been employed, the explanation given of their benefit being that the energy of the moving column of gas in the pipe exerts a pull upon the engine piston. This is not a satisfactory explanation, and the benefit, if any, would only be secured by the use of a gradually tapering pipe, so as to allow the gas to finish at a lower velocity. But probably the true cause of the gain is the cooling effect of the long pipe. The volume of gas is reduced, and there is less displacement of the atmosphere. Thus, in the case assumed, a reduction of the gas temperature of about 260° F. would reduce the expulsion effort by one-half, or nearly 2½ H.P. It would add a clear 10 per cent. to the power of the engine.

There must be many cases where the exhaust of a gas engine could be cooled between the cylinder and the point of entry into the atmosphere without serious obstruction of the flow of the gas. The effect of such cooling would be shown clearly upon the enlarged scale indicator diagram. With hydrogenous gas the exhaust is largely steam, which would practically disappear with a really cold condenser. A gas engine condenser should be cheap to make; its internal pressure would always be higher than that of the atmosphere, so that tightness would be of no material account. Its use is the same as that of the steam engine condenser—namely, to reduce the volume of the exhaust gas, and therefore the work done in pushing aside the atmosphere. The doing of this work manifests itself as increased back pressure on the piston, but the fine scale of the diagram has prevented this from being sufficiently appreciated.

NOTES ON IRON LOSS.

By F. Lydall.

(*Concluded from Vol. 56, page 1006.*)

On comparing the two sets of curves, it will be seen that the agreement is very good indeed up to an induction of about 18,000; but that above this point the observed values are higher than the calculated values.

There are three possible ways of accounting for this, and it may be that they are included in the real explanation. First, the hysteresis may increase more rapidly than the 1·6th power as soon as saturation is reached.

Secondly, if the induction curve is much distorted from a sine wave, as explained above, the curve of the eddy currents will be similarly distorted, and the R.M.S. value will be greater than that calculated on the basis of a sine wave.

Thirdly, the magnetising winding, due to lack of space inside the ring, was not uniformly spread round the ring, but was wound in four sections, thus:—

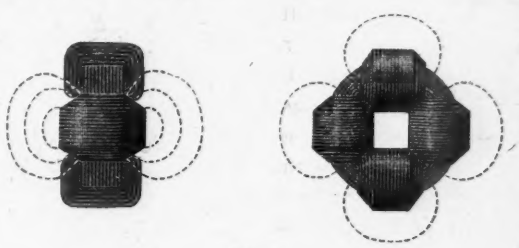

Fig. 4.

It will be obvious that for very high values of the magnetising current there will be a certain amount of magnetic leakage; and any such leakage field will produce eddy currents in the plates.

Of these three possible explanations, a high degree of probability can be assigned to the second and third. It might be thought that the actual value of the hysteresis could be deduced from the two observed curves by analysis; but the curves do not seem to be sufficiently accurate to warrant such treatment. The determination, therefore, of the law of hysteresis at high inductions must remain doubtful.

No claim is put forward for regarding these experiments as anything but qualitative. The inherent difficulties and possible sources of error can be easily understood when one considers that the experiments were made in the testing department of a factory with a home-made wattmeter; and, further, that the wattmeter had to read accurately with a power factor as low as 3 per cent. The results, however, seem to justify the conclusion that the total iron loss in a

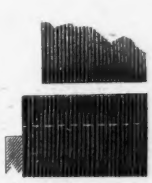

Fig. 5.

number of laminations subjected to alternating magnetisation up to 22,000 C.G.S. lines per square centimetre can be calculated from the usual formulæ for hysteresis and eddy currents with an accuracy quite sufficient for most purposes.

The *raison d'être* of the experiments was to ascertain whether the losses in the highly saturated teeth of modern direct current dynamos could be calculated by the ordinary rules depending on the density and the frequency. The results applied to this problem go to show that the discrepancy alluded to above cannot be credited to the losses in the teeth. It is, of course, possible that the eddy currents from plate to plate may vary with the density, but it seems

unlikely. If, then, the above experiments can be relied upon, one way of accounting for the discrepancy has been eliminated.

In the writer's opinion, the solution of the problem is to be found by examining in a general way the curves of iron loss of a number of machines. If several such curves be compared, the following general conclusions will at once be obvious in all cases :—

1. The curves do not follow throughout their range either the law of the 1·6th power or the law of the square.

2. The shape of the curve changes gradually from approximately the square to higher powers.

3. This change invariably takes place when the saturation curve begins to bend over.

4. The higher up on the saturation curve, the greater is the slope of the iron loss curve, or the higher the power of its variation.

From these observations there is only one conclusion to be drawn when taken in conjunction with the experiments described above. From these experiments it is fairly safe to assume for practical purposes that the hysteresis loss varies as the 1·6th power of the induction even up to the highest values. The conclusion to be drawn, therefore, is that there is an additional eddy current loss which depends upon the saturation.

In almost all cases the first portion of the magnetic circuit to become saturated is the teeth, and it is therefore reasonable to argue that this additional eddy current loss changes its law of variation as soon as the teeth approach saturation.

Further, if we analyse the iron loss when the teeth are unsaturated, we still find that there is a considerable loss in addition to the hysteresis and normal eddy currents in the plates themselves. We therefore arrive at the following conclusions :—

1. At all values of the induction in the armature of a direct current dynamo there is a loss other than the normal hysteresis and eddy currents.

2. This additional loss, to a certain extent, follows the saturation curve, and depends partly on the saturation of the teeth.

In casting about for some suggestion to explain this additional loss, it must be admitted that there is very little reason for locating it in the teeth themselves. Any eddy currents caused by filing the slots should vary approximately as the square of the density, and it is very difficult to imagine any reason why such eddy currents should increase very rapidly as the teeth approach saturation. It is similarly just as difficult to suppose that eddy currents from plate to plate in the body of the armature can satisfy the same criterion—viz., that of increasing very rapidly as the teeth approach saturation.

If, therefore, the teeth and the body of the armature are eliminated, there remain only the surfaces—viz., the inside surface, the outside surface and the ends. The air ducts may be left out of account, as the peculiar shape of the iron loss curve is unaltered by the presence or absence of these ducts.

Consider now the possibility of eddy currents in the end plates of the armature caused by magnetic flux entering them from the poles.* In most armatures the laminations are pressed up together and kept in place by means of thick end-plates of iron, extending from the shaft or the spider, as the case may be, to within ¼ in. of the roots of the teeth. Now the lines of force that enter these plates from the outside will be proportional to the magnetic difference of potential between the poles and the body of the armature—in other words, to the ampere-turns per pole for the air-gap and the teeth. The eddy currents produced by this magnetic field will vary as the square of the magnetic density and as the square of the frequency. Putting this into the form of an equation, and calling E W the additional loss under consideration, A T the ampere-turns per pole for the air-gap and the teeth, f the frequency = r.p.m. × number of poles ÷ 120, and k a constant depending on the dimensions of the machine—

$$\text{E W} = \text{K} \times (\text{A T} \times f)^2.$$

Now, this equation certainly does fulfil the foregoing criteria. It represents an eddy current loss, as it varies with the square of the frequency; further, the loss will roughly follow the saturation curve, and will vary as the square of the density below saturation, and will increase much more rapidly as saturation is approached.

The writer has analysed a great many curves with the object of finding out how far this explanation holds good, and also to determine the constant K; and he has found that, in many cases, this rule holds good throughout the entire range of the observed curve. In some cases the coincidence of the predicted and observed curves was not good, but taking into consideration the fact that there was no means of finding out the hysteretic quality of the armature iron, and that in any single case there might have been further losses due to filing the teeth, the writer came to the conclusion that in the majority of cases the additional loss could be accounted for as explained above.

The constant K will, of course, depend on the dimensions of the end plates, but for the construction shown in the accompanying diagram (fig. 5, p. 3) the formula could be written—

$$\text{E W} = 1{\cdot}15\ d \left(\frac{\text{A T}.\ f}{s}\right)^2 10^{-8} \text{ watts},$$

where d is the diameter of either end plate in inches, A T the ampere-turns per pole for the air-gap and teeth, f the frequency = r.p.m. × number of poles ÷ 120, s the depth of the slot in inches.

It must not be supposed that this eddy current loss in the end plates is the only loss that can occur in addition to the normal hysteresis and eddy currents in the laminations. Other losses can, no doubt, occur under certain circumstances, such as surface eddy currents due to filing out the slots, eddy currents between laminations due to slight motion rubbing off the skin of insulating oxide, or even at high saturations eddy currents in the solid copper conductors.

If the above theory is reliable, all that can be said for it is, that it will enable the designer to calculate the minimum iron loss that will occur in any given case.

To a scientific designer, however, such knowledge is of great importance in two respects, viz., in regard to the actual amount of the iron loss, and in regard to the localisation of the various components.

For any given machine, the iron loss will depend partly on the length of the air-gap and on the saturation of the teeth, and by using the above method the designer will be able to determine what price has to be paid for what is called a stiff field. Thus for any given set of conditions there should be some definite proportion between the slots, teeth, air-gap, &c., to enable the greatest output to be obtained from an armature of given dimensions.

Secondly, the heating of electrical machinery forms a distinct problem in itself. One of the chief difficulties in this problem is to know to what extent the total watts lost in a machine can be pooled together as affecting the temperature rise of the machine. There is no doubt that the distribution of the losses cannot be disregarded; in the case of a direct current armature the proportion between the watts lost in the conductors and the watts lost in the iron must be taken into account, and these watts cannot simply be added together. The best method of dealing with this problem is outside the scope of these notes, but the localisation of the various components of the iron loss should certainly afford some assistance in studying the question.

In conclusion, the writer would suggest that the above explanation as to the iron loss could be very easily tested, either by taking comparative curves on the same armature with different air-gaps, or by fitting magnetic shields over the end plates, in the form of masses of iron as nearly as possible covering the ends of the armature, and remaining stationary while the armature revolved.

Acknowledgements are due to Messrs. Siemens Bros. and Co. for permission to publish this account of the experiments carried out at their works at Woolwich.

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* Eddy currents in the ends of an armature have been mentioned, among other possible sources of dissipation of energy, by Prof. E. Wilson.—*Proc. Roy. Soc.*, June, 1902.

Erratum.—The paper on "Iron Loss" referred to on page 1004, Vol. 56, as by Mr. Mordey, was the joint production of Messrs. W. M. Mordey and A. G. Hansard.

INTEREST ON DEPOSITS.

[By Our Legal Contributor.]

The question whether those who supply electricity for lighting purposes under the terms of a provisional order have any power to refuse to pay interest on deposits paid to them by consumers has recently been considered in the City of London Court. It is an important question, not from the point of view that there is a large sum of money at stake, but owing to the fact that the payment of interest to a very large number of consumers must inevitably complicate the accounts of an electric lighting company.

It appears that the judge decided (*a*) that where a consumer has paid a deposit to secure the price of a meter, the company or local authority must pay interest on the deposit; (*b*) that the deposit cannot be applied in payment of an account for energy supplied, unless the consumer assents to that course.

Let us inquire into the law applicable to these two questions.

The law as to the provision of meters for the measurement of electric current appears to be founded upon, but nevertheless differs in important particulars from, that which applies to gas meters. By the Gasworks Clauses Act, 1871, Sec. 14, "the undertakers shall supply to any owner or occupier of premises within the limits of the special Act requiring the same, a meter for registering gas supplied by them: Provided always, that such owner or occupier shall, if required, previous to receiving such meter, give to the undertakers security for payment to them of the price of such meter if he desires to purchase the same, or of the rent of such meter if he desires to hire the same." By this Section the obligation to give security only arises if the consumer desires to purchase or hire the meter. In the case of electric meters, it is provided by the Electric Lighting (Clauses) Act, 1899, that "where the value of the supply is under the special order required to be ascertained by means of an appropriate meter, the undertakers shall, if required by the consumer, supply him with an appropriate meter . . . . provided that previously to supplying any such meter the undertakers may require the consumer to pay to them a reasonable sum in respect of the price of the meter, or to give security therefor, or (if he desires to hire the meter) may require him to enter into an agreement for the hire of the meter as hereinafter provided." Clause 55 provides that a meter may be hired on terms arranged between the parties, or, in case of difference, as may be determined by the Board of Trade. Assume, then, that the undertakers simply demand and receive a sum of £2 as security for the price or hire of a meter; are they entitled to retain the interest on this sum?

It is submitted that unless there is some special provision allowing a consumer to demand interest, he must be taken to have agreed to forgo the interest as part of the consideration for his use of the meter. Otherwise it would appear that he is (in effect) allowed to have the meter free of charge, for the undertakers are bound to return the *corpus* of the deposit when the consumer ceases to take a supply.

Further, by the common law of England, there is no right to interest upon money, except by contract; and in an ordinary contract for repayment of money lent, or for payment for goods sold, there is no implied contract for payment of interest.

The same considerations appear to apply to a claim for interest on a deposit paid for the express purpose of securing the charges for current supplied. Thus, where a provisional order contains the following clause: "Every owner or occupier of premises requiring a supply of energy . . . shall give to the undertakers (if required by them so to do) security for the payment to them of all moneys which may become due to them by such owner or occupier, in respect of any electric lines to be furnished by the undertakers and in respect of energy to be supplied by them," it is apprehended that interest need not be paid by the undertakers.

The above opinion is based on the statute law; and inasmuch as there may have been a special agreement to pay interest or other exceptional circumstances attending the case in the City of London, it does not necessarily conflict with the judgement in that case.

As to the second question, there would appear to be no room for doubt that where a deposit is paid to secure the price or rent of a meter, that deposit cannot be applied to arrears of money due for energy supplied.

THE ROYAL SOCIETY CONVERSAZIONE.

At the second Royal Society conversazione of the season, held at Burlington House on June 23rd, there were very few novelties in the physical or electrical departments of science. A considerable number were exhibited at the previous conversazione in May, and these we have already described.

The General Electric Co. exhibited several examples of the "Osmi" incandescent lamp. This lamp in appearance is similar to the ordinary electric lamp, but in place of carbon the filament is made from the rare metal osmium, which when in a state of incandescence glows with extreme brilliancy. The advantages claimed for this lamp are: high fusing point, white light, higher efficiency, longer life and less heat. The blackening of the bulbs is said to be inappreciable. The consumption of power with the ordinary carbon filament is 3·5 to 4 watts per candle-power; the consumption with the Osmi lamp is 1·5 watts per candle-power.

Messrs. Siemens Bros. & Co., Ltd., had on view a specimen of the recently introduced tantalum lamp, described in our issue of January 27th last. The resistance of tantalum being much lower than that of carbon, a much greater length of filament is required for the 110-volt lamp. The filament is wound in zigzag fashion on an insulating support, in the necessarily restricted space in the bulb. The efficiency of this lamp is stated to be the same as that of the Osmi lamp—namely, 1½ watts per candle-power. The lamps exhibited required ·3 ampere at 110 volts, and gave a light of 25 N.C.

Dr. W. J. Russell, F.R.S., exhibited photographs showing some curious effects of wood on the photographic plate. The pictures were produced by placing polished surfaces of wood in contact with the photographic plate in the *dark*. The action on the plate is supposed to be due to the action of a gas generated in the woody fibre. The photographs of the fibre of the wood obtained in this way do not always resemble those obtained in the ordinary way by illuminating the surface.

A new kind of sundial designed by Prof. Albert Crehore was shown by Sir W. H. Preece. The gnomon of the common form is abandoned, and the shadow of a small bead fixed on a wire is cast on the interior of a true cylindrical surface, upon which figure-of-eight curves are drawn, marking standard noon for each day of the year. The cylindrical surface is inclined, so that its axis, upon which the bead is fixed, is parallel to that of the earth. It thus represents the latitude of the place. The shadow of the bead travels across the cylindrical surface parallel to or on one of the circles drawn thereon. These circles represent days of the months. Each hour described in the circle is always of the same length, and a scale of minutes engraved on the cylinder enables true mean time to be read off directly to a few seconds.

NOTES ON M.E.A. DISCUSSIONS, 1905.

The first paper of the session, which dealt with the subject of "Load Factor and its Effect upon an Electricity Station," was read by Councillor Sinclair, and called forth sundry criticisms at the hands of Mr. J. F. C. Snell, of Sunderland. The latter demurred to the author's load factor values, preferring to halve them as far as his own experience went; he further considered that £60 to £70 per KW. of plant installed being a usual figure, the author's figure of £120 per KW. of maximum demand, on which he had based a cost curve, was much too high. As regards the shortcomings of

the maximum demand system, he was in agreement with the author, and felt that its days would be numbered so soon as electrical supply conditions approximated to those obtaining in connection with gas, by which time a flat rate would become general. In order to meet the severe competition of gas in Sunderland, his department had laid itself out to supply the large works, and he anticipated that it would sell 7,000,000 power units this year, and 11,000,000 next; the coal per unit generated had already fallen from 8 or 9 lb. to 4·8 lb., with a load factor of some 47 per cent.

Both Bailie Willock (Glasgow) and Mr. H. Boot (Tunbridge Wells) dissented from the last speaker's views regarding the maximum demand system: but Mr. H. Faraday Proctor (Bristol), although a user of the latter system, was in agreement with Mr. Snell. The system, he pointed out, was correct in principle, but its fault lay in that it regulated the charge according to the individual consumer's demand, and not according to the class of consumer.

Mr. E. E. Hoadley's paper on "Street Lighting" drew a considerable expression of opinion of a not very hopeful character as to side street lighting by electricity and as to the means available for that purpose.

Thus Mr. G. Wilkinson (Harrogate) pointed out that for this important work practically the only hope at present was the Nernst lamp. The latter was a monopoly, made only in Germany, and it was impossible to get improvements or modifications in constructive detail carried out. The average life test of his lamps was 580 hours, and 1,000 hours he regarded as the maximum useful life for street lighting purposes. He reminded the author that in converting street lamps it was necessary to allow for the residue of capital expenditure on the displaced lamp.

Councillor Stevenson (Edinburgh) contributed some interesting figures regarding the Edinburgh street lighting, from which it appeared that the cost per annum of the two-burner Nernst lamps was 45s., as against 44s. for the incandescent gas lamps. In regard to the arc lamps, which will shortly number 1,200, the last instalment would cost per annum £9 10s. each only, as compared with £9 16s., the cost of the four incandescents which each one replaced.

Mr. Wilmshurst (Derby) commended the arc for main street lighting, but expressed disappointment at the short burning hours of the flame arc. He attributed much of Mr. Hoadley's success in street lighting to his large revenue per lamp, a figure quite double that obtaining in many localities. He further found fault with the construction of the Nernst lamp, and recorded but poor results from its use.

Mr. Haydn Harrison drew attention to the published results of Mr. Bradley, of Westminster, and Mr. Pearce, of Manchester, which he considered showed the inferiority of the incandescent gas mantle; he further suggested that some common practical basis of comparison was necessary, and

Mr. Fedden, following, considered it all a matter of price—an opinion which is certainly borne out by the fact that at Sheffield, where the price of gas is only 1s. 2d. per thousand cb. ft., there is no public electric lighting. Mr. Fedden's extended trials of different types of lamp led him to favour the Tantalum lamp, and he is fitting a number of these two in series on 200 volts, the power consumption being less than 2 watts per candle.

Curiously enough, if we remember aright, only one speaker referred to the Bastian mercury vapour lamp as a medium for side street lighting. Such lamps, rated at only ½ watt per candle, have burned for 2,500 hours in the St. Pancras streets, although that does not represent their limit; and taking account of their simplicity, adaptability and cheapness, both in first cost and renewals, we were prepared to hear considerably more of them than we actually did.

Turning to the Glasgow meeting, at which Mr. Kilgour's paper on "Costs and Tariffs, &c.," claimed first place, it was apparent that the majority of the members were in favour of a simple system of charging, and furthermore, that it should be based rather on the commercial possibilities of the case, than on the costs of supply.

The question of preferential treatment of, say, a power consumer having works close to the generating station was raised by Mr. Shawfield (Wolverhampton), it being impossible to frame either flat rate or sliding scale, which would treat such a consumer, and one at a considerable distance from the station, equally fairly. Against this, of course, it may be argued that all consumers have a right to equal rates, they not being responsible for the location of the generating plant; this argument is clearly of little value, as the principle of giving good terms to the most profitable consumer underlies nearly all systems of charging.

Alderman Robb (Tunbridge Wells) gave expression to the troubles involved in connection with the maximum demand system of charging, and in finding a suitable substitute. Business men will appreciate his remark, that the scientific aspect of the sale of electricity should be strictly confined to the works, and should not in any way enter a consumer's premises. He considered it impossible to classify consumers, and suggested that the question would be solved eventually by a flat rate for ordinary work and special charges in special cases.

Mr. J. F. C. Snell (Sunderland), whose advocacy of flat rates excited some comment on the previous day, pointed out that underlying them was the maximum demand principle. His method of fixing charges was to calculate the costs of the last year, and estimate those of, say, two or three years ahead; with these limits it was possible to fix a mean price, which, although barely profitable in the first instance, would be so a few years ahead; this method he recommended, as being easily understood by a committee.

As to whether it is legally possible to differentiate in favour of individual consumers, much doubt seemed to exist. Alderman Pearson (Bristol), however, pointed out that in changing their town clerk they had changed their legal opinion, and judging from what has been accomplished elsewhere without hindrance, the difficulty in the majority of cases would appear to be more imaginary than real.

The second paper read at Glasgow was by Councillor Hodgson (Salford), and dealt with the question of power supply by municipal authorities.

This paper, which was dealt with on p. 1076 of our last issue, led to somewhat protracted remarks from the civic representatives of Bristol, West Ham, Poplar, Sunderland, &c. As might be expected, all were agreed that the power companies must be excluded from their respective areas, and that to this end it was necessary to be in a position both to give a supply and to quote power rates comparable with those of any competitor. Instances were given of the policy pursued by Bristol and Sunderland, although the prices quoted for power supply appeared somewhat high.

Alderman Pearson (Bristol) stated his belief that financially everything favoured the municipality as against the power company, and that, in any case, the majority of the latter would never get as far as practical operation.

Although the financial status of municipal electrical work is at least open to question, and though it may never happen that the boroughs represented by the worthy councillors are entered by a power company, yet to the latter is due the sudden awakening and great solicitude for the welfare of the power consumer, so much in evidence at the meeting.

The remaining contributions to the proceedings came from Mr. A. B. Mountain (Huddersfield), who dealt with "Extensions to Outlying Areas," and Mr. A. R. Sillar (Colchester), whose subject was "Free Wiring."

The former paper led to an expression of opinion that the outside bodies were averse to taking a supply from a central authority, on the ground that this was a first step towards incorporation with the latter.

Mr. S. L. Pearce (Manchester) thought that such extensions were often inadvisable from an engineering point of view, from his experience in the Manchester district, and, furthermore, that difficulties existed in the carrying out of overhead transmissions in any but rural districts.

Mr. R. A. Chattock (Birmingham) considered that Parliament did not favour outlying distribution by central authorities, although such a system was cheaper for the outside community than buying and distributing for itself.

Both speakers agreed that the Board of Trade was not favourable to overhead mains, and that a uniform price over the whole area of distribution would be a necessity. In regard to the latter, however, the representatives of Birkenhead and Eastbourne pointed out that they were already supplying such outlying areas at an increased price, and had

experienced no difficulty from the B. of T. To sum up, it would appear that local prejudice is the great obstacle to the development on commercial lines of electricity supply in outlying areas.

The figures given by Mr. Sillar, in the last paper of the session, were the subject of much discussion, evidently varying according to the locality with which the speaker happened to be acquainted, and being generally regarded as too favourable. The deficiencies of the average slot meter were generally conceded, although Mr. Sillar expressed complete satisfaction with the working of the B.T.-H. prepayment meter, adopted in Colchester.

Mr. E. T. Williams (Gibraltar) referred to his experience in that town, half the revenue being derived from prepayment installations. He commented on the unfairness of charging extra per unit, as in that case the good consumer paid more than the bad one. In Gibraltar a hire-purchase system at 15s. per lamp was in vogue, the installation becoming the property of the user in 14 years; for smaller installations a fixed charge of 1s. 6d. per 8-C.P. lamp per month was made, dispensing with meters, &c.

Mr. Vignoles (Grimsby) had known many free-wiring contractors go bankrupt before their installations were paid for, and Alderman Butterworth (Derby) expressed the opinion that there was no real security for free-wired installations, an opinion which is supported in more than one quarter, and is generally justified.

On the whole, speakers in the various discussions were not lacking, and one is bound to concede the fact that the average councillor found much more to interest him and to talk about (especially the latter) than in former years. This is a good sign, if, as we believe, it indicates a more thorough comprehension of the business of electricity supply, a knowledge of which has not necessarily accompanied the holding of office under such circumstances heretofore.

M.E.A. ANNUAL BUSINESS MEETING.

The annual business meeting of the Association was held at Edinburgh on Friday, 30th ult., the retiring President, Mr. F. A. Newington, presiding. The first business was the selection of a President for 1906, and Mr. J. E. Edgcome, of Kingston-on-Thames, was duly elected, it being also agreed that next year's conference should be held in London.

The other office-bearers elected were: Mr. S. E. Fedden, Sheffield, and Mr. C. D. Taite, Salford, vice-presidents; Alderman G. Pearson, Bristol, hon. solicitor; Mr. J. H. Rider, London, hon. treasurer; and Mr. H. Faraday Proctor, Bristol, hon. secretary. The Council was elected as follows: Alderman Bruce, Sunderland; Alderman E. Elvy Robb, Tunbridge Wells; Alderman J. P. Smith, Barrow-in-Furness; Bailie Willock, Glasgow; Councillor Sinclair, Swansea; Mr. R. A. Chattock, Birmingham; Mr. W. Lackie, Glasgow; and Mr. Day, Bolton.

Mr. J. H. Rider submitted the annual report, from which it appeared that there had been a continued increase in the membership, the total now being 391. The principal matters which the Council had dealt with were the Supply of Electricity Bill, and the Board of Trade and Home Office proposed revised regulations. Referring to Local Government Board loans, the report commented on the hardships imposed by the lack of uniformity in terms for the repayment of loans, it being felt that some united action should be taken in this matter. The Supply of Electricity Bill in its present form, the report said, was much improved, and possessed many good features. It, however, did not appear to define as clearly as desirable the limitations of the powers conferred on the Board of Trade.

The treasurer's report stated that the Association had £187 1s. 4d. in hand, as against £141 5s. 3d. in 1903.

Alderman J. P. Smith (Barrow-in-Furness), referring to Local Government Board loans, moved a resolution to the effect that the meeting viewed with serious apprehension the recent action of the Local Government Board in reducing the already short period for the repayment of loans for electrical undertakings, and empowering the Council to take such steps as were thought necessary to secure more equitable and uniform terms.

Mr. J. F. C. Snell, in seconding, said they were prepared to take a period of 25 years, but not one of 20 years.

The resolution was adopted unanimously.

Baling Press.—Mr. H. I. Roberts, of Victoria Chambers, 42, Castle Street, Liverpool, is showing at the Colonial and Indian Exhibition at the Crystal Palace, his patent baling press, driven by a 2½-H.P. G.E. Co.'s motor. These presses are designed for baling cotton, wool and jute, and, it is claimed, possess exceptional advantages in the way of ease of working and economy, as compared with hydraulic presses.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Imperial Preferential Policy.

Though taking two columns of your space to criticise, in the style of the very superior, but anonymous person, a small shilling book on a subject with which he says "the country is getting a little bored," your reviewer does not think it worth while to give any idea of the date of these reprinted lectures. Had he done so, his criticisms would be liable not to have the same point to the impartial reader.

Your reviewer suggests that my position as a believer in the *theory* of Free Trade, whilst pronouncing myself as opposed to its present form, in practice is illogical. In reply, I can only repeat, if Free Trade were practised throughout the world, there would, in my opinion, be no need for fiscal reform. Moreover, I see no objection to the term Protection when used in a political sense any more than when used in a general sense. I am not, however, in sympathy with those who desire Protection merely for selfish reasons, connected with their own particular business only, and who are in no way concerned with the position of their country and its empire as a whole. This was the Protection first brought forward many years ago.

Your reviewer expresses many statements of opinion as though they were statements of fact. For example, he says "throughout the book Chamberlain is the Court of Appeal." Your reviewer also indulges in various cheap forms of sneer, and quotes single sentences without giving the context or general sense of my remarks. Further, he finds it convenient, apparently, to refer to the fact that I do not give a large number of statistics, but omits to mention my reason for not doing so. He also fails to refer to the circumstance that these lectures were intended as a preliminary survey, and that I expressed my intention of dealing with the various branches of the subject in greater detail later.

Your reviewer takes up the line that, as a matter of course, his knowledge of political economy must be greater than that of the author he is anonymously reviewing; but I suggest that there is no necessity to drop gentlemanly consideration for your fellow beings, because you do not happen to agree with them—especially in political matters.

I am disinclined to go into your reviewer's remarks in detail. No useful purpose would be served thereby with a "cock-sure" individual at the other end. We all know it is uncommonly easy to write in the style of criticism indulged in by your reviewer. I should be glad, however, if your reviewer would read some recent remarks of Mr. James Swinburne (for whom, if he is a member of the same profession, he probably has as much respect as I have) on the subject of reviewing. Mr. Swinburne is, I believe, a worthy representative of the Free Import School, and for this reason, too, his remarks may appeal to your reviewer. Mr. Swinburne comments on the fact that we have too many anonymous reviewers who find it necessary to adopt the "superior person" tone that I allude to. The impartial mind of any worth is not, as a rule, convinced by such a tone.

I am glad to see that, on p. 1002, the Electrical Review, in its leading article, is willing to adopt Mr. Chamberlain's phrase, "think Imperially," and wants its readers to "think Imperially," even though in the same number it publishes a review which is largely taken up with condescending adverse criticism concerning Mr. Chamberlain.

Charles Bright.

Reform Club, *June 28th*, 1905.

P.S.—As an example of your reviewer's contention that "the country has shown itself to be surfeited with the subject," he says that "publishers find that the demand for literature on the subject shows a remarkable falling off." If, however, he cares to inquire from my publishers—Messrs. P. S. King & Son—he will find that some 350 copies of the book under review were sold within the first fortnight of publication, and that at the present time there are only 81 copies remaining in stock.—C. B.

The Value of Consular Reports.

The omniscience of the commercial attaché is a thing that must astound all those who are not personally acquainted with that gentleman.

He is, no doubt, a man with an abnormal mind, and what he does not know cannot be worth knowing. One attaché is appointed by H.M. Government to answer every kind of commercial inquiry relating to France or Belgium, another is supposed to be able to deal with all the details of the trade of Austria-Hungary, Italy and Greece, while a third keeps an eye on what is happening in such little places as Germany, Denmark, Holland, Sweden, and Norway.

All this is very wonderful—in the words: "And still the wonder grew, that one small head could carry all he knew," our state of mind may be summed up.

Your readers will probably continue to wonder to some practical issue. At all events, the Electrical Review is to be congratulated for setting another stone rolling.

H. S.

"A. A.'s" comments upon the subject of consular reports will, it is to be hoped, have drawn additional attention to your able leader upon that theme. For any nation having a defective intelligence department to hope to realise commercial prosperity through the world's markets is absurd. For such a nation as Great Britain, which is essentially a trading community, to neglect to inform herself upon all matters touching in any degree the commerce upon which her existence depends, would be to seek extinction.

Every Britisher, and all who know the British character, will be certain that this country's trade would not be permitted to leave these shores without a desperate struggle on the part of John Bull & Co. That goes without saying. Already, however, pressure is very heavily upon us, in our electrical industry often cruelly so, and to wait until depression in foreign trade compels us to hold, as with bull-dog tenacity, to the trade we own by acquisition, and, therefore, love, would be to add misery to the struggle. Already we are on our mettle, and every manufacturer and shipper means to be, for is it not a fact that our electrical exports are practically stationary?

When Great Britain first became a trading community, her traders worked as self-contained individuals, each acquiring by his own wit the intelligence concerning his own trading house. The nation is now grown to first rank in the commercial world, and some of the conditions have become modified. The question for to-day should, therefore, be, Are our means of acquiring intelligence concerning our industry efficient, and could the cost be reduced?

"A. A.'s" suggestion that the manufacturers should tackle the question seems to be good and timely. To the Review we owe the suggestion that our consular reports should be dealt with by technical experts. In no other branch of industry is this more marked than in electrical engineering, which, as every engineer will recognise, abounds in technicalities beyond the scope of any but the highly-trained specialist. Such an expert, if properly selected, should be able, by fulfilment of his office, to very materially increase our foreign trade, and at a time when money circulates as hardly as at present, foreign trade is indeed, a boon.

As to whether this specialist should be a Government official or a servant of our own institution, another pen may perhaps deal.

B. B.

The state of things to which attention was called in the leading article of your issue of June 16th would appear to account very largely for the curious coincidence, that the first person we meet on arriving at a Continental centre of commercial activity is usually the German representative of a competing firm, who appears to have settled there about two days earlier.

It is difficult to say if this is due to more perfect organisation of the Commercial Intelligence Department of a country which has always been celebrated for co-operation amongst its traders, or if it is merely evidence of the resources at the command of very extensive private concerns.

We appear to be inclined to throw the onus of the matter, as usual, upon the Government; but surely the function of the Government is rather to protect the trader as he goes about his business, than to come and call him in the morning. It must, also, be a matter of some delicacy for a Government official to show himself actively interested in endeavouring to secure early information in the interests of his own country, as it were, though really in the interests of commerce generally.

An association for the purpose of keeping the home firms well informed, supported by subscription of those firms receiving the intelligence, and having representatives at suitable centres, reads very well, but might not commend itself to the parties interested, amongst whom competition is necessarily keen.

The most satisfactory solution would appear to be for the matter to be taken up by some society which already has members in every country, such as the Institution of Electrical Engineers. Of course, one would not anticipate that every member could, with justice to his employers, enrol himself as agent, but there must be a very large number to whom it would be possible. A central bureau to receive and disseminate the information gathered would complete the organisation. The expenses might be met by special subscription from the recipients of the information; or even a small percentage devoted out of the present contributions without seriously affecting the quality of the post-symposial coffee.

C. B.

Indication of Leakage, and the Home Office Rules.

In your issue of June 30th, Mr. M. B. Field very rightly draws attention to the disturbing effect of capacity currents in connection with the various three-phase leakage indicators which have recently been described in your "Correspondence" columns. We venture to think, however, that he is wrong in assuming that the designers of such instruments have overlooked this matter.

It is really a question throughout of whether absolute or comparative indications are required. In the case of direct-current systems, we have, as already mentioned, devised an apparatus by means of which both the leakage current and the insulation resistance of each main can be *absolutely* determined. In the case of three-phase systems, however, owing to capacity currents and other causes, it is, as Mr. Field points out, a much more difficult matter. As a matter of fact, however, the capacity current will be almost constant from day to day, so long, of course, as the same sections of cable are employed. That being so, any increase or decrease in the deflections obtained indicates a change in the insulation of the system, for better or worse, as the case may be.

We shall hope shortly to publish some typical readings taken on our various instruments; for the moment, however, we may say that, as far as our experience goes, the capacity currents do not generally reach serious proportions.

It should be remembered that we are now speaking only of insulated systems, and that these are, as a rule, low tension.

The following set of readings, which were recently sent us, are interesting in this connection:—

Reading on line A, 0 milliamperes.
" " B, 72 "
" " C, 71 "

It should be mentioned that the resistance of the instrument in this case was 3,500 ohms, and the voltage was 550.

With reference to Mr. Field's remarks on the subject of instruments for earthed systems, it should be mentioned that Rule 7 only lays down that leakage indicators are to be fixed on wholly insulated systems, but the Home Office inform us that they consider the use of leakage indicators on earthed systems also to be very useful. Under these circumstances, however, it is not, of course, essential that the instrument should accurately indicate the thousandth part of the leakage current, but should rather serve as an indicator of the occurrence of a fault which would be too high in resistance to be discovered in the ordinary course.

We quite agree with Mr. Field as to the difficulty of winding transformers for a constant ratio at all currents.

Everett, Edgcumbe & Co., Ltd.,
Kenelm Edgcumbe, *Director.*

Westminster, *July 4th*, 1905.

Costs of Power Generation.

As a matter of interest to the electrical trade in general, but more especially to those engaged in the sale of machinery and current for power purposes, would it not be possible for you to publish in your valuable paper an article dealing with the cost per B.H.P. per hour of the various motive powers, such as steam, town gas, suction gas and oil, giving, at the same time, the price allowed for coal, gas or oil, as the case may be, and allowing a fair and reasonable amount for maintenance, depreciation, &c., but ignoring the question of skilled or other labour for running same?

Being engaged myself in pushing the sale of electric motors, I find the manufacturers do not know the actual H.P. being used by them, and not being in possession of the necessary figures myself, I should, and I have no doubt many others would, find them most useful in combating the statements of our rivals.

Motive Power.

[The great difficulty in the way of adopting our correspondent's suggestion is that of finding anyone qualified to speak with the authority of wide personal experience on all these points. If readers who are interested in the subject will furnish us with brief statements, each based upon personal knowledge of one or other of the agents named, we shall have pleasure in publishing them in a suitable shape for reference, provided that sufficient data are received.—Eds. E.R.]

Novel Methods in Australia.

We are learning something new every day. According to Mr. E. Kilburn Scott, M.I.E.E., A.M.I.C.E., in a certain Australian station, when one of several compound-wound generators, running in parallel, is taken off load, they have discovered that by cunningly inserting shunt resistance—presumably by means of the field rheostat—the current taken from the machine in question may be reduced to a minimum, and a very small arc is the result of switching out. Perhaps Mr. Scott will tell us how this is usually done in similar cases if not in the manner described.

Equaliser.

A correspondent inquires for the names of firms who make a light portable punch for shipyard work, driven by an electric motor through a chain.

Another correspondent wants to know the name and address of the manufacturers of the "Bandy" arc lamps.

MUNICIPAL TRAMWAYS ASSOCIATION (ANNUAL CONFERENCE.)

Appropriately enough, this Association held its annual Conference at the Agricultural Hall during the opening days of the Tramways Exhibition, and considerately enough the business of the Conference, as represented by the papers which were read, was neither of sufficient bulk nor of importance enough to withdraw the attention of the members for any length of time from the much more interesting business which awaited them outside.

Mr. Alfred Baker opened the proceedings of the Conference with his Presidential address, which covered the usual ground in the able fashion for which we are accustomed to look.

The membership has not increased so rapidly as in previous years, but there are 55 corporations and 82 managers and chief assistants enrolled. The total capital sunk in the undertakings represented by members exceeds twenty-one millions sterling.

Mr. Baker waves the scalp of the Chicago tramways companies in triumph, and chuckles blood-thirstily at the thought that British example supplied the knife. He expresses the hope that it will be kept whetted for future use, and considers that the action of Chicago should stifle the arguments which the opponents of municipalisation have drawn from American freedom and individualistic scope.

Personally, we think it unwise to adorn arguments for either side by American illustrations, and we cannot refrain from suggesting that although "it must be remembered that the civic life of America is comparatively young . . ." it is older in vice than ever we hope to see the equivalent British institutions. Chicago sent for Mr. Dalrymple, of Glasgow, to teach it how to set about municipalising its tramways, but Mr. Dalrymple is reported to have seen such sunken rocks ahead that he thinks poorly of the city's prospects in its new endeavours.

Knowing, as we know, and as all the world knows, to what base uses the powerful forces of municipal control are put in many American cities, and how much more powerful those forces would become if the vast tramway systems were put into the same side of the scale, we cannot applaud the sense that prompts the champions of local government in England to make capital out of the dubious moves of the local politicians of America, for such a course will re-act unpleasantly later on.

Mr. Baker proceeded to speak of the possibilities yet before tramways in the almost unexplored field of parcels and goods traffic on a large scale. The suggestion made by Mr. Bellamy in his presidential address last year, that the Association should confer with representatives of municipalities and County Councils as to the preparation of a memorandum on the subject for presentation to the Minister of Agriculture, has been considered during the past year by the executive committee, but no definite proposal was to be laid before that meeting, as the subject is so large and important that more time has to be spent over its consideration.

Let us hope with Mr. Baker that the scheme may fructify during the coming year, and let us suggest that the inclusion of certain private tramway interests in the future conference would tend to make the eventual solution of the problem more universally satisfactory.

A good deal of stress was laid on the crying need for increased speed limits on tramways, and effective use was made of the Liverpool concessions, which are well known to our readers. The helpful evidence of the Chief-Constable of Liverpool before the Royal Commission on London Traffic was quoted again. It is to the effect that increased speeds have resulted in an actual decrease in the number of street accidents.

In view of the recent perturbation of the public mind over the revolution which motor vehicles were to make in street traffic, Mr. Baker did well to mention the subject at some length. He quoted the only published figures (outside the pages of a prospectus) relating to the cost of running motor-'buses. They refer to Hastings, and appeared in the *Tramway and Railway World* for February 7th. They read as follows:—

General repairs and tires per mile	3·50d.
Wages (conductor, driver, cleaner, &c.)	2·50d.
Oil, fuel, &c....	2·00d.
Other expenses, including depreciation at 20 per cent.	3·50d.
Total	11·5d.

Mr. Baker stated further that the result of a year's working shows a heavy loss, and he compares the above total with the average cost per mile of six of the largest electric tramways in England, which comes to 6·12d., and to 7·15d. only when the interest and sinking fund on the permanent way and overhead equipment are taken into account. We might add, in justice to the motor-'buses, that a further addition ought to be made for depreciation, but it would be difficult for the most pessimistic accountant or auditor to annihilate the outstanding balance of 4·354d. in favour of tramways by the inclusion of this item.

Tires, of course, are the chief trouble. They cost 2d. to 2½d. per car-mile, and Mr. Baker estimates the cost per 'bus per annum for tires alone at £342, whereas the corresponding cost for steel tires, running only 50,000 miles per tire, is £5 5s.

Perhaps Mr. Baker might have gone on to explain that motor-'buses have a distinctly useful field, which is likely to be exploited and much extended in the future.

With a few remarks on the danger of standardisation affecting progress, the address was brought to a close.

That Mr. Rider is too busy to write papers is reflected in the paper which he read on "Charges for Supply from Combined Lighting and Traction Stations," for in the doubtful

phrase of an unlettered humorist of our acquaintance, much of it "has got whiskers," being occupied by an explanation of the elementary principles on which all tariff systems of charging are based.

The author does little to prove his thesis, which, in reality, needs no proof, but confuses the issue by mixing up cost of production and selling price. He says, for instance:—"To show the absurdity (of regarding the costs of generating at separate traction stations given in certain statistical tables as standing for the real total costs) we have only to ask whether they (the undertakings owning the stations) would sell energy at the total costs there given, plus 10 per cent. We have an answer from Glasgow, where, although the so-called total power costs were only ·41d. per unit, 1,243,532 units were sold last year to the electricity department at an average price of 1·47d. per unit." And he proceeds immediately:—"There is no doubt that in some cases the price charged for tramway energy is too high. . . ."

He clinches the argument by the use of an isolated instance, to which the very fault which he exposes in the next sentence appears to attach in rather an exaggerated form. But have we nothing to say for Glasgow? Whether we agree with her policy of separating the two supplies is outside the immediate question. Mr. Rider refers to the emergency supply which the Glasgow tramway plant gave to the lighting mains, and he wants us to see with him that the charge of 1·47d. per unit is excessive if the total costs were only ·41d., and that the latter figure is really incorrect.

It may be true that it does not include all that ought to be included before such a complete title can be applied, but Mr. Rider forgets for the moment the very point that he presses later, that the million odd units sold at 1½d. were supplied (we take it) under the high maximum demand and low load factor conditions of a lighting station, and formed a tithe only of the total output.

If such an emergency supply had been sold by the tramways to the lighting department at a price three times that of the total cost, the use of the illustration would have been more than justified.

We like the paper in that it may bring home to many of the councillors who heard it the conscience-stirring thought that the tramways in their respective towns are being mulcted for the sins of the lighting undertaking, but that is a point which has been sharpened and dug in by us, and by our contemporaries, so often that no councillor should have been unprodded, although many may be unrepentant. But then . . . .

It does seem an obvious proposition that a town owning both tramways and lighting, is well advised to reduce the mean total cost of both services by using the virtues of the one to palliate the shortcomings of the other, and to debit each with the actual cost of generation as nearly as it can be ascertained in each case, instead of playing a game of shop between two pockets of one purse.

The discussion on Mr. Rider's paper was about as illuminative as a penny dip in a fog.

No worse place than Berner's Hall in which to hold a conference can be imagined. Underneath our feet the floor heaved with the thud and boom of the gas engines in the basement, from the right came a hubbub of street traffic passing over stone setts, while the rear was bombarded by the cheerful blast of the Luton Red Cross Band.

Mr. McElroy thinks that the question of a combined or separate generating station for traction and lighting is one which is answered according to the point of view of the speaker. For the sake of the honesty of the parties to the discussion we should hope that he is right. He believes, with us, that the true point of view is that of the municipality, not of a department or individual. In this he was supported by several speakers, notably Bailie Alexander, of Glasgow; Treasurer Lyon, of Aberdeen; Alderman Hay; and Mr. Peter Fisher, of Dundee. But there were others who floundered about in a comical and withal a tedious way, trying to prove, by the handle of their own village pump, that separation is the best policy.

Mr. Spencer, of Bradford, acknowledged that hitherto the price to be paid by the tramways department for energy supplied by the electricity department has been settled as a bargain between antagonistic committees, but he thinks that sounder views are about to prevail. He was ill-advised enough to start quite gratuitously the depreciation hare, and said enough to show that he is a heretic of the worst kind. Mr. Tittensor, of Preston, kept him company by remarking, in the course of a speech which might have had been shorter, that the depreciation fund ought to be looked on as "available profit." His whole speech was more local and dogmatic than impartial and broad.

Bailie Alexander took our ground in explaining that the 1¼ million units annexed by Mr. Rider for his own purposes, were generated at a time of peak load in the lighting system, but were charged at 1½d. instead of 6d., which was the rate charged by the lighting department for the same units to consumers.

Mr. Peter Fisher paved the way for Mr. Rider's reply by re-stating the principles which the paper enunciated. Mr. Rider had asked, Can combined stations supply all services better than separate stations, and suggested that the price of traction supply from a combined station should be based on the well-known principles of the maximum demand system.

The discussion, however, had gone off on the lines of "Do combined stations supply tramways on better terms than would be obtained from a separate station?" and "the price at which combined stations actually supply tramways is outrageous."

Mr. Rider further elaborated those remarks, and laid stress on his real contention, that there ought to be one electricity department, which should control the whole supply of energy for any purpose whatever, and that if a proper and equitable basis of charge were formulated by every central committee, there would be no room for the troubles adumbrated by some of the speakers.

Those are really sound principles, and if every chairman and manager who heard them enunciated were to go to his own place revolving them in his mind, he would find himself shortly drawing in deep breaths of a wider and purer atmosphere than he had previously dreamed of.

Municipalism runs too much to air-tight compartments, and the men who help to knock down the intervening bulkheads will live to rejoice in the free air of the single house, in which each man's work adorns the whole, rather than the chamber in which he lived before.

Mr. Luntley's paper on "Motor-'buses" is of but little value, as it is not based on ascertained figures or experience of any sort.

Mr. Blain, as we all know, has decided views on the subject of "Rules and Regulations for Tramway Employés," and his remarks are to be respected as those of an expert. We agree that vicarious discipline, as expounded by too many managers, especially of the smaller undertakings, is deleterious, however you look at it, and some definite code of rules, such as Mr. Blain recommends, ought to be put into the hands of every driver, conductor and inspector. Those rules should be as simple in form and wording as they can be made, should be as few as possible, and, above all, should be respected.

THE THIRD INTERNATIONAL ELECTRIC TRAMWAY AND RAILWAY EXHIBITION.

THIS Exhibition was opened by the Earl of Derby on Monday last, his inaugural speech being followed by a luncheon to 300 guests, at which Mr. J. W. Courtenay presided, supported by the Earl of Derby, the Hon. Arthur Stanley, Sir Chas. Rivers Wilson, Sir Edmund Monson, Lieut.-Col. H. A. Yorke, Sir Guilford Molesworth, Mr. Hadfield, Mr. Alex. Siemens, and many other gentlemen who are well known to the engineering profession and tramway industry.

After the loyal toasts the Earl of Derby proposed "The Industry of Transport," which he traced from the uncertain time when man first used a log of wood to roll burdens which he was too lazy to carry, up to the present day. Nevertheless, the speech was neither so long nor so tiring as one or two which followed, and the comparative statistics

given by the noble Earl were most interesting. Some of them may be reproduced :—

Year.	Miles open for traffic.	Cars, horse.	Cars, electric.	Passengers.
1878 ...	269	1,124	—	146,000,000
1903-4...	1,840	2,336	7,132	1,799,500,000

Lord Derby also quoted a table dealing with the present-day electric traction, 1898 the height of the steam period, and 1879 the horse period of the tramway :

	1903-4.	1898.	1879.
Capital expenditure per mile of single track	£16,018	£10,649	£9,877
Percentage of net receipts to capital outlay	6·27	6·38	3·97
Percentage of working expenses to gross receipts	66·15	76·93	83·81
Passengers carried per mile of route open	977,951	806,703	469,641
Average fare per passenger ...	1·11d.	1·23d.	1·84d.

His Lordship pointed out, in conclusion, how great was the future for electric traction in local haulage. He touched on most of the subjects which have held, and still engage, the attention of the men who control our magnificent transport facilities, and foreshadowed still further advances in the near future.

Wise caution marked his comments on the possibilities of electric traction on main railway lines, which have set the unbalanced imagination of some untechnical writers ablaze, but he was hopeful that recent experience on the branch lines of the N.E. and L. and Y. Railways, as well as on the underground railways in London, would result in the substitution of electricity for steam on many branch lines.

He felt that the time would come—and he could not understand why it had not come before—when other traffic besides that of passengers would be conveyed in some form by tramways. The day must come when a great deal of the traffic would be distributed by tramways, then perhaps by motors, the one feeding the other, and the great railway lines acting as arteries. It was not infrequently found that where there were two competing lines and an attempt was made at first to cut rates that the traffic had increased proportionately, so that finally there was work enough for both.

Other toasts followed.

The germ idea of exhibitions in general is to bring together under one roof the completest possible collection of articles which are required, or which some people think ought to be required, by that section of the community which is interested in one way or another, and the success of an exhibition is to be gauged, therefore, by the degree of completeness which it displays, and by the manner in which it meets the real or fancied wants of the public for which it caters.

It is at an exhibition that the busy man sees, in whatever time he has to spare, the material contents of all the catalogues which have been sent to him during the last year. Those catalogues either swelled the patient W.P.B., or were put aside under the pious impression that to-morrow or next week there would be five minutes to spare for their examination.

When an article is examined critically in the pages of a catalogue, as often as not it is by the light of the reader's unaided intelligence ; at an exhibition, which partakes of the nature of a living catalogue, the light of a specialist's intelligence illuminates the particular points which are claimed as advantages for everything which catches the wandering visitor's eye, and sales which are, let us hope, mutually beneficial, will result.

The educative influence of an exhibition is one of its most valuable attributes, for it brings together in a way which is impossible otherwise the thousand and one necessities, conveniences and luxuries which go towards making a business successful, and it provides the men who from lack of inclination or time do not read the literature of his subject, and the men who have to stick at home from one year's end to another, with an opportunity for bringing themselves up to date at a bound.

It is for these reasons that every engineer and manager of the tramways of Britain should be permitted by his directors or committee to attend this present exhibition, for it provides in a manner which excites our admiration for the energy and organising faculties of the promoters and exhibitors, all the advantages of which we have written, in an exceptional degree.

We shall deal with the various exhibits in some detail in later numbers, but in this place we can do no more than write of the general impression which the exhibition has printed on our mind.

There is nothing like an exhibition to indicate the progress which an industry has made in a given time, and this one ought to supply that indication when compared with the Exhibition which was held in 1902.

Although the number of exhibitors was slightly greater in 1902 (184 against 163), and notwithstanding the fact that several large manufacturers such as the Westinghouse, B.T.-H., and Dick, Kerr, have stood out this year, we believe that in point of quality this Exhibition is on a higher plane than the last.

It seems to us to set a keynote of homogeneity in the tramway industry which was absent from those which preceded it. There is hardly an amateurism in the building. The three years which have passed between the second and third exhibitions have wiped out the faddist and the crank to a degree which must surprise even those who are most sanguine of the general sanity.

One of the most gratifying features of the Exhibition is its absolute demonstration of the power of British manufacturers to supply every want of a tramway, from the largest power station to the smallest button on a conductor's uniform —not, of course, that there are as many large stations as small buttons on view. It is, in fact, a triumph of Home over Alien industry.

Of surface contact systems there are still four, and the best of them—the Kingsland—has not yet been permitted to demonstrate its qualities outside an experimental track.

It is somewhat remarkable, and gives food for reflection to the thoughtful, that there is only one surface-contact system of Continental origin on exhibition, although it is from the Continent that we have heard so much of them in time past. Surely they have not failed !

We must own to disappointment at the meagre display of rails. Although there are no foreign rails here, the fact is notorious that contracts still go abroad, and this was an opportunity which British steel makers need not have missed, to bring their goods before the eyes of their countrymen—and others.

It is with a feeling of deep satisfaction that we record the failure of the crop of life-guards and dry seats which flourished so exceedingly in 1902. Presumably we have got down to bedrock in these matters.

In trucks there is not much novelty except in the two rival exhibits of radial-action single trucks. The radial truck is well known to the Patents Office, and it is improbable that any patent of the principle is valid, so that we need be interested only in the particular application of the general principle. We fear the demand for long-base single trucks will be so large that many will be tempted to the pitch of bitter disappointment and the loss of money in their endeavours to go one better than the last.

In ordinary tramcars there are improvements in detail only, but improvements which by no means are to be despised, for as with trucks, so with cars and all other gear, the perfection of detail is the criterion of successful operation.

An opportunity is given to all to see for themselves the beautiful simplicity of the Thermit process of welding, and we believe that the next few years will witness an astonishing advance in the number of tramway undertakings which have used this system to overcome the vital disease of the joints to which almost all are subject at the present time.

The display of switchboards and gear, including circuit-breakers, switches and all kinds of electrical instruments, is remarkably complete and interesting.

In the overhead equipment department there is not much of novelty, but every type of fitting is represented on several stalls. So far as we could see, there was but one device for earthing fallen wires, which compares favourably with the numbers shown in 1902. As the B. of T. are not pressing for the installation of such safety devices, it is probable that

they shrink from forcing expensive experiments down the throats of the tramways, which they have half garotted already with guard-wires and other devices for the protection of the P.M.G. and the public, while they recognise that better than any automatic bag of tricks is a line well-constructed and well maintained. Cables and accessories are well represented.

In 1902 a motor-car was a curiosity and a motor-'bus non-existent; this year the latter are to be seen all over the floor, looking very spick and span, and suggesting nothing of evil smells, or vibration, or 2d. a mile for tires.

Perhaps the greatest novelty of the Exhibition, certainly the item which will draw the engineer as honey draws the bee, is the continuous-current three-phase traction equipment which is to be seen on Stand 48. Many, too, will not have seen in the flesh an example of the single-phase repulsion motor, which is exhibited on this stand.

An exceptionally representative selection of modern technical literature is on view and for sale, for the first time at these exhibitions, at the stand of the Electrical Review.

The general exhibits will be dealt with in greater detail in future issues.

RAIL BONDING.

A thoroughly sensible and practical paper on this vital subject was read by Mr. Ricker before the American Institute of Electrical Engineers, and reprinted in the March number of the *Street Railway Journal*.

We English have been forced to pay closer attention to keeping down the resistance of the return circuit than have the Americans, for, while the citizens of that country have a legal remedy when the tramway current eats up their gas and water pipes, our tramways are not allowed to start that game, and the only way in which they have avoided doing so has been by taking particularly good care about the bonding of the rail joints. This being so, it would be natural to suppose that the Americans would have to come to us for the latest improvements in the design, manufacture and application of bonds and other jointing devices.

It is true that there are hundreds of miles of tramways in the remoter States which retain the absurdly inefficient bonds of 15 years ago, while there is probably no single mile of track in Great Britain which has not two bonds per joint and cross-bonds "every so often," unless, of course, a still better system is in use; but on how many of those miles will the curious investigator discover one bond either of British design or manufacture? We cannot recall to memory a single all-British design, and only recently have any considerable number of bonds been manufactured within our shores!

We have made practically no improvements in the design or the application of bonds, but we have been lazily content to take what was given to us by the Americans.

Until recently the standard practice in this country was to use solid wire bonds which stretched across the fish-plate and terminated in riveted heads of various shapes. These were named Chicago, Crown, Neptune, &c., and were used in numbers which bore for the first few years no particular proportion to their relative merits, but more to fashion or to the interests of the contractors. Some dropped out by degrees as our native consulting engineers became educated in their new line of business, and for a time there was little divergence from one design of head. Latterly catalogues have been swelling in the bond section, and the chief run seems to be on the short flexible "fish-plate" or "concealed" type. The earlier of these were made in three parts, solid terminals being welded to a stranded body which was flattened by compression. Most joints, when any type of bond has been but newly applied, will test well, but faults in design, manufacture or application will show themselves later without fail, and the risk about these welded bonds is that the welding is incomplete, for it is most difficult to weld pure copper perfectly, on account of the readiness with which it oxidises at high temperatures. The obvious improvement is to eliminate the welding altogether by forming the whole bond out of stranded copper under high compression. If that can be done so perfectly that the contact surface of the terminals has lost the minutest appearance of corrugation, the bond will be as good as can be wished, but if perfection in this respect cannot be attained the contact surface must deteriorate gradually and certainly by corrosion and oxidation.

This type of bond is not mentioned in the paper under review, but it is suggested that the nature of bonds to be used on a contract should be inspected just as carefully as any other part of the material. The welded terminal type may be inspected "by sectioning the terminals in various places, polishing the cut surfaces with a smooth file, emery, and crocus to remove all burrs, and then etching with a mixture of strong sulphuric and nitric acids, when the defective welds will show as fine black lines, and the actual welds and the form of the various component parts of the bond at that surface can be traced by the different colours of the metal after etching."

The concealed bond was introduced in the States primarily to foil the worthies who have now taken to removing high-tension transmission wires without the consent of the owners. Bonds external to the fish-plates, and easily accessible as they would be on so many miles of unpaved track, proved too rich an outcrop to escape the notice of these prospectors, and the only thing for the owners to do was to contrive bonds which might be put under the lock of six fish-plate bolts. The concealed bond resulted, and followed the general features of the long solid bond which it replaced. The next thing the owners knew was that the movement of the rail-ends was loosening the bond terminals or alternatively breaking the neck of the bond. As the rails were laid on sleepers just like a steam railway, this flexibility of the rail-joints was not a thing to be cured, so the bond was improved by being made flexible. Now we who deal only in the solidest of solid paved track may find that a 6-in. bond under the fish-plates is cheaper than a 30-in. external bond, but the flexibility of the bond should not matter one way or the other, for there ought not to be any flexibility in the rail-joints under such conditions. Nevertheless, movement of rail-ends is not quite unknown even in England, so it will be just as well for purchasers of short bonds to have them made of stranded wire, or in any better way to secure flexibility.

We (meaning we British) have seldom heard of troubles due to bonds breaking or to the loosening of terminals from rail movement, and that is not because rail movement has been absent, but because the terminals have been beyond the area of disturbance. It will be interesting to hear from anyone who has had troubles of the above description.

A few years ago a certain amalgam bond was boomed extensively, but was taken up to no great extent in this country. The author of the paper, which we have rather neglected, informs us of the utter failure of this type of bond after from two to four years' service on an American line. He warns us, too, against the use of soldered joints.

The best area of contact surface has been a subject of discussion, but the best result will be got by not worrying so much about the diameter of the terminals as about the certainty of intimate contact over the whole surface inside the web of the rail, for while the selection of the bond is important, the proper application of the type selected is much more so.

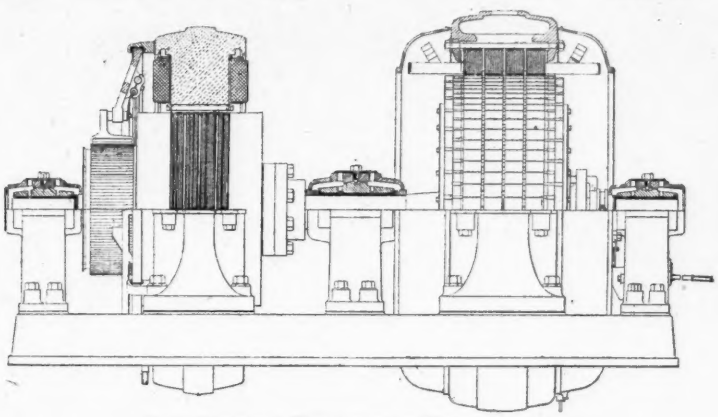
While discoursing on bonds, we ought to say that the best method of joining rail-ends under British conditions is, to our mind, to weld the rails into one piece, with, perhaps, occasional reversions to the most rigid mechanical rail joint bridged for electrical purposes by a good copper bond carefully applied. Wherever the rails are exposed, of course rail welding is out of the question.

Train Lighting.—The three new and sumptuous trains which have been brought into use on the Great Western Railway for the London-Penzance service, and in connection with which many interesting and novel features have been introduced, represent an entire departure from established practice, and raise the standard of comfort in railway travelling to a higher plane than has elsewhere been attained. It is significant, therefore, to note that the Leitner-Lucas system of electric lighting, of which we gave a description in our issues of March 17th and 24th, has been installed on each of these trains, by the Accumulator Industries, Ltd., of Woking, in an improved form.

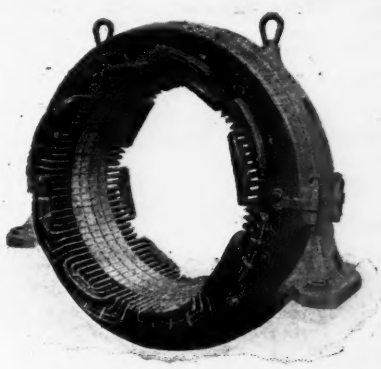
MOTOR-GENERATORS FOR ACTON.

The accompanying illustrations relate to the new motor-alternators which have been supplied to the Acton U.D.C. by the Lancashire Dynamo and Motor Co., Ltd. The motors will take current from the Metropolitan Electric Supply Co.'s mains at 10,000 volts, 60 cycles, two-phase, without transformation, and it is to be noted that this pressure is 10,000 volts to earth (the outer conductor of each cable being earthed), not 5,800 volts, as it would be if the supply were 10,000 volts three-phase. The induction-motor stators are built up of specially-selected sheet-iron, and the coils are laid in half-closed slots lined with special mica insulating tubes, which extend some distance on either side of the core.

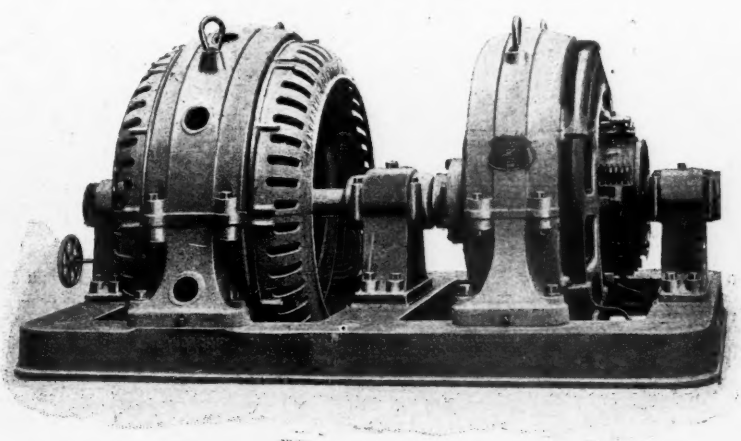
All the coils are former-wound, and are insulated and taped up at the end, afterwards being served with varnish in such a manner as to make the whole air-tight, thus preventing any damage which might result from static discharge.



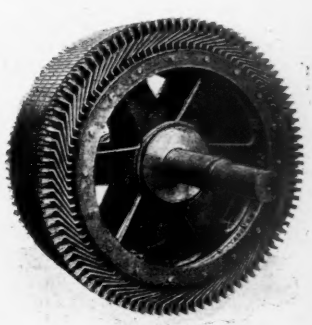
Part Sectional Elevation of Motor-Generator.



10,000-volt Stator.



View of Complete Set.



Rotor.

Lancashire D. & M. Co.'s Motor-Generators for Acton U.D.C.

The rotors are also built up of laminated plates with half-closed slots, and the winding, consisting of copper bar, is laid in these slots and connected together by heavy copper end connections. These end connections are held in position by special wedge-shaped rings, making a first-class mechanical job. The slip rings are of brass and the brushes of copper gauze.

The generators are rated at 250 kw. each, 550 amperes at 460-500 volts, and the sets run at 440 r.p.m. The magnets are six-polar, the field coils being former-wound and taped. The brush-gear is of the makers' standard type, and the armatures are of the slotted drum type, bar wound. The machines are designed to stand heavy overloads without undue heating or sparking.

The yokes are of cast-steel, with steel poles and specially shaped pole-pieces to prevent sparking. Ample ventilation is provided inside and outside the coils. The bearings are of the spherical-seated self-oiling type. The armature core is also well-ventilated, and is mounted on a cast-iron sleeve, extending from the bearing to the coupling, of which it forms one-half; the commutator is also carried on this sleeve.

Harrow en Fête.—On Friday last King Edward visited Harrow in connection with the annual Speech Day, and the considerable extension to the playfields of the school. The town of Harrow, in celebration of this event, specially illuminated the streets with the Union Excello flame arc lamps, with very satisfactory results.

LEGAL.

In re Julius Sax & Co., Ltd.

In the Chancery Division of the High Court on June 29th, before Mr. Justice Swinfen Eady, Mr. E. F. Ford, on behalf of a debenture-holder, applied for the appointment of a manager of this company, his Lordship having appointed a Receiver last week. Counsel read an affidavit by the managing director of the company, giving evidence as to details of the business. From this it appeared that the company had been carrying on business for nearly six years. The business was for the wholesale supply of electrical accessories. It was expedient that a manager should be appointed. The whole issue of debentures was £1,200, of which the plaintiff held £600, and there was a valuable turnover and goodwill.

His Lordship made the usual order in a debenture-holder's action, and appointed a manager (Mr. T. S. Wederell) to carry on the business under existing conditions, adding that an amendment might be made and the application treated as a motion for judgement.

Alleged Defective Electrical Sparking Plugs.

In the Lord Mayor's Court, on Tuesday last week, before Mr. F. S. Jackson, assistant judge, and Mr. Cozens-Hardy, electrical expert, as assessor, the case of Réne & Co. *v.* Wolf came on for hearing. The plaintiffs, who carry on business at Snow Hill, sought to recover a sum of £20 12s. 1d. in respect of certain Fafnir electrical sparking plugs sold and delivered to the defendants, Messrs. Wolf & Co.

Plaintiff's Counsel said the matter was one that had been referred by the Recorder, Sir Forrest Fulton, K.C., at a previous sitting of the Court, as one involving a question of electrical engineering knowledge, to be tried before the assistant judge with the assistance of an electrical expert. The defendants alleged that the plugs supplied were not according to sample, and that the bulk of the plugs were faulty, being short-circuited.

After hearing evidence, the Assistant Judge said that the assessor had intimated his willingness to take away a certain number of the plugs which had been supplied by the plaintiffs to the defendants, to test them himself. In that case he should reserve his decision until after the assessor had given his opinion.

Driver Acquitted.

At the Middlesex Quarter Sessions on Saturday, William Goodchild surrendered to his bail on an indictment for wantonly driving an electric tramcar at Edgware Road, Cricklewood, causing bodily harm to two men. The grand jury threw out the Bill, and Sir R. Littler, K.C., discharged the accused.

Midwood & Co. v. Manchester Corporation.

This case came before the Court of Appeal on the 27th ult.

The plaintiffs, it will be remembered, obtained judgement against the Corporation for £677 in respect of damages arising from a fault on the defendants' mains.

It was directed that the Corporation's appeal against the above decision should not be listed until yesterday.

Telephone Disconnection Case.

The National Telephone Co. sued Mr. Henry John Barclay, of Silverdale, Sydenham, for £2 7s. 6d. in respect of a telephonic service supplied. Defendant denied liability on the ground that he had given instructions to remove the instrument and cut off the connection. It being proved that he had recently used the instrument, judgement for the amount claimed, with costs, was given.

Swansea Telephone Litigation.

The N.T. Co. has entered its appeal against the judgement recently given by Mr. Justice Buckley in favour of the Swansea Corporation.

Lloyd's v. Marconi International Marine Communication Co., Ltd.

Mr. Justice Kekewich, in the Chancery Division on Wednesday, concluded the hearing of an adjourned summons in this action by the defendants against the plaintiffs asking for a further and better affidavit of documents.

Mr. P. O. Laurence, K.C., and Mr. Ashwood appeared for the plaintiffs, and Mr. Stewart Smith, K.C., and Mr. Gover for the defendants.

Mr. Stewart Smith, for the applicants, said the action was by Lloyd's, well known in the insurance world, against the defendants, and was brought upon an agreement of September 21st, 1901, of which both parties in the action claimed specific performance. Each alleged that the other had been guilty of breaches of the agreement, so that a large number of issues were raised. The International Co. had obtained from the Marconi Wireless Telegraph Co. the right to the use of the Marconi Wireless Telegraph Co.'s patents in respect of maritime information. The International Co. had entered into an agreement with Lloyd's to allow Lloyd's the use of the invention for the purposes of obtaining information which was called maritime signalling, and maritime signalling was defined by the agreement as being the collection, publication and diffusion of all such intelligence and information as was at present collected or diffused by Lloyd's, but the International Co. had retained for itself sea telegraphy, which was also defined and contrasted with maritime intelligence. Sea telegraphy included the receipt and transmission of messages to and from passengers on ships, and this right was very valuable to the International Co., who had retained the right to Lloyd's signalling stations. These, however, under the terms of the agreement were to be worked by Lloyd's. There were a number of points in dispute between the parties, and the defendants had set up a counterclaim and in their defence traversed the claims made by the plaintiffs. Lloyd's had contracted with the Admiralty, with regard to certain signal stations, and the defendant company had asked for disclosure of certain documents, but as an affidavit had been put in from the secretary to the Admiralty, stating that it would be to the detriment of the public service if these documents were disclosed, he could not ask for disclosure of these particular documents. It was the defendant company's case, however, that there was an arrangement or projected arrangement between the Admiralty and Lloyd's, by which some information which would probably come under the heading of sea telegraphy, would be given to the Admiralty by Lloyd's. If that were so, it was an extremely serious thing for the International Co., because they had rights under their patents, and neither the Admiralty nor any other Government department had any right to use the patents without making the International Co. proper compensation. Lloyd's reply was a denial that they were handing over the working of the defendant company's system to the Admiralty, or to anyone acting for them. The learned Counsel said he asked for a further and better affidavit of documents, but if his Lordship thought that was too wide, then he would ask for disclosure of documents relating to Lloyd's title to signal stations and documents relating to Lloyd's Committee.

Mr. Laurence submitted that there was no need for the order, and that it was mere curiosity on the part of the International Co., so that they might see what arrangement Lloyd's made with the Cape Government with regard to stations out there, and that it did not affect the matter at issue in the action.

His Lordship, in giving judgement, said he had come to the conclusion that he should order a further affidavit of documents. As to the point made with regard to the title of Lloyd's to the signal stations, it seemed to him that on that point the defendants were wrong. The costs would be costs in the action.

To "Motor" Manufacturers.—The British Empire Motor Trades Alliance has received an inquiry for the names and addresses of British firms who manufacture gear boxes, axles and steering connections. British manufacturers of the above and of motor engines are requested to communicate with Mr. J. B. King, secretary, 11, Red Lion Square, W.C.

BUSINESS NOTES.

Bankruptcy Proceedings.—J. T. Armstrong.—The public examination was held on Wednesday before Mr. Registrar Giffard, at the London Bankruptcy Court, of James T. Armstrong, Moorgate Station Chambers, whose accounts show total liabilities £6,933 and an estimated surplus in assets of £7,101. Under examination by Mr. E. Leadham Hough, Senior Official Receiver, the debtor said he had during the past 10 years given his attention mainly to electrical and other inventions for wireless telegraphy, telephones, and torpedo boats. He claimed to hold some 40 patents, under which it was possible to direct torpedoes in a novel manner, and to exercise control over the projectiles for some distance from the firing point. For some years past he had been short of capital, and with a view to obtaining some relief, in October, 1902, he assigned his business and patents (other than those of Norway and Sweden) to the General International Wireless Telegraph and Telephone Co., Ltd., which was registered with a nominal capital of £175,000. The only cash subscription was £1,615, and that was provided by himself. As vendor he received £120,000 shares. Some of them he sold for £5,000; a considerable number was given to other persons for services rendered and to be rendered, and the remainder were held by creditors by way of security. Witness acted as managing director of the company, which, to all intents and purposes, was a one-man company. He still regarded himself as a solvent man, and hoped to pay the creditors 20s. in the £. His present position was caused by financing the company, pressure by creditors and inability to realise his share holdings in the General International Wireless Telegraph and Telephone Co., Ltd. In the deficiency account he had valued his shares therein at par. Two years ago the shares were quoted in the financial Press, and blocks had been sold at 25s. to 30s. per share. The Official Receiver: Then why could you not realise your holding? Witness explained that, unfortunately for himself, a pool was made, and all his shares were locked up, while those held by other persons were sold. His unsecured liabilities were chiefly in respect of money borrowed on behalf of the company. The examination was concluded.

The first meeting of creditors of Gerald Leslie, 5, Denning Road, Hampstead, electrical engineer, will take place at Bankruptcy Buildings, Carey Street, on the 12th inst., at 11 a.m., and the public examination at the same place on August 4th, at 11.30 a.m.

Portable Petrol Dynamo. — Messrs. De Dion Bouton, Ltd., of 10, Great Marlborough Street, W., send us a photograph of one of their 15-h.p. four-cylinder petrol dynamo combinations, complete with water and petrol tanks, radiator fan and switchboard, fixed on a horse-drawn vehicle made with tubular frame. The whole forms a complete movable electric power installation developing 10 kw., and is specially suitable for lighting for military work, travelling exhibitions, &c. The dynamo is specially light, aluminium being used wherever practicable to reduce weight. These light petrol-dynamo combinations are also used on motor-propelled vehicles with electric transmission. An electric department where dynamos, motors, accumulators, dry batteries, &c., are made, forms an important portion of the De Dion Bouton factory, a large demand being experienced for petrol-dynamo combinations for lighting country houses, &c. A handsome catalogue has been issued giving particulars of combinations up to 8 h.p., and one set, which is used for lighting the company's workshop at Islington, can be seen there in operation.

Zoelly Steam Turbine.—A powerful syndicate has been formed in Germany, consisting of the great engineering firms of Krupp, of Essen; Maschinen-Fabrik, of Nurnberg; Augsburg Nord-Deutsche Lloyd, Escher Wyss & Co., and Siemens-Schuckert, for constructing the Zoelly turbine for marine and other purposes in Germany, and elsewhere on the Continent; and a similar combination has ben made in France, under the leadership of Messrs. Schneider, of Creuzot. In England a syndicate has been recently formed consisting of Messrs. Escher Wyss & Co., Messrs. A. G. Schiff & Co., and Messrs. Mather & Platt, Ltd., of Manchester, for the construction and sale of the Zoelly turbine in the United Kingdom and British Colonies, and for granting licences under the Zoelly patents. Already Messrs. Escher Wyss & Co. and their various licensees have over 30,000 h.p. of turbines at work or under construction, including several for marine propulsion, and have realised a notable success with the first turbine constructed by them for electric light and power, which has been at work for some months in the Central Station at Muhlhausen, in Thuringia.

Change of Address.—The Sir Hiram Maxim Electrical Co., Ltd., which has acquired the assets of the lamp and accessories business recently conducted by the Sir Hiram Maxim Electrical and Engineering Co., Ltd., has established its head office at 38, Gillingham Street, S.W.

Cost of Service Cables.—The City of London Electric Lighting Co., Ltd., sued Mr. Paul Dvorkowitz, formerly a printer, of Bevis Marks, for £7 7s. 9d., the cost of laying certain electric cables for the supply of current. The plaintiffs' case was that the defendant required electric current to be supplied to his premises, and entered into a contract by which he agreed, in the event of his not taking electric energy for a period of three years, to pay the cost of laying the cable to the premises, which were beyond the distance to which plaintiffs were bound, under their statutory powers, to supply. The defendant admitted that he had signed the contract referred to, and the jury found a verdict for the plaintiffs for the amount claimed.

Outings.—On Tuesday, 27th ult., the employés of the Hanwell line of the London United Tramways, Ltd., had their annual outing. They left Hanwell station by a special train for Henley-on-Thames, where a launch was in readiness to convey them up the river to Caversham Bridge, Oxford, arriving there at 12 noon. A capital dinner was provided at Thames Valley Hotel. After the usual toasts had been honoured, the party went for another trip up the river, arriving back at Henley at 7 p.m., where an excellent tea was provided at Broad Gates Hotel. There were 110 men present, as well as a number of guests, and a most enjoyable day was spent. The party arrived at Hanwell at 10 p.m.

The heavy rain of Saturday morning in no way damped the spirits of the Robertson Electric Lamp Co.'s employés, who started for Margate in a special train soon after 8 a.m. The beanfeasters had for months past looked forward to their annual outing, and they meant to enjoy it despite the weather. The sun was shining brightly when the company detrained, and Margate looked particularly clean and inviting after the downpour. The staff dined at Lilley's Hotel under the presidency of Mr. C. Wilson, the company's joint manager. One of the most popular toasts proposed was the "Robertson Electric Lamps, Ltd." In the afternoon the staff drove to Birchington and Minster, and on returning to Margate a second substantial meal was served at Lilley's Hotel. It was nearly midnight when the excursionists arrived at Victoria, just in time to catch the last train to Hammersmith, after a most successful and enjoyable outing.

Public Lighting in India.—The latest volume of the "Judicial and Administrative Statistics for British India" states that the municipal expenditure on lighting is gradually increasing. In the year 1898-9 the expenditure was £113,869, whereas in 1902-3 it amounted to £127,380. At present there are not half a dozen municipalities actually using electricity as an illuminant for their streets. There are a large number of cities in which electricity supply licences have been granted or are pending, so a large business may shortly be expected in the supply of arc lamps, standards and incandescent lamps for street lighting. It is to be hoped that the Indian Government will differentiate in its returns between the amounts expended on gas, oil and electricity for municipal lighting.

Trade Announcements.—Messrs. C. W. Waters, Ltd., of 72, Great Eastern Street, E.C., who have carried on business for many years as shellac bleachers and manufacturers of methylated spirit, varnishes, polishes, &c., have made satisfactory arrangements for the transference of the business to a new company, which will carry it on under the same name and on the same lines as hitherto. The new company will have a capital of £40,000, the directors being Messrs. Stanley Hoare, F. A. Glaeser and W. R. Honeywell. The company has undertaken to discharge in full the trade debts of the old company. The new works which have been erected at Brimsdown for the manufacture of the various specialities for which the firm has become noted will be in full working order within the next few weeks.

Mr. G. Stevenson, of 65, Renfield Street, Glasgow, has assumed Mr. H. A. McGuffie, A.M.I.E.E., as a partner. The business will be carried on under the name of Stevenson & McGuffie, at the above address.

The Dover branch of Messrs. Lea & Warren has been taken over by Mr. L. T. Young, the firm's former manager there, and will be carried on as L. T. Young & Co., electrical engineers, Dover. Mr. Young will be responsible for debts dating from June 10th.

Messrs. H. J. Cash & Co., Ltd., of 1, Belvedere Road, S.E., S.E., announce that (from June 24th) they have removed to temporary offices in Tothill Street, Westminster, S.W., to which address all communications should be sent.

Mr. H. Greenway Goodman, who for some years was with the Edison and Swan U.E.L. Co., Ltd., at their Broadheath and Ponder's End Works, has commenced business as an electrical contractor at 183, Westbourne Grove, London, W.

The Sir Hiram Maxim Electrical Co., Ltd., has acquired the assets of the electric lamp and accessories business recently conducted by the Sir Hiram Maxim Electrical and Engineering Co., Ltd., and some of the liabilities of the latter.

Mason's Gas Power Co., Ltd., of Alma Works, Levenshulme, has acquired the works and business in gas producers and furnaces carried on by Messrs. W. F. Mason, Ltd., including the sole rights in the Duff & Whitfield patent gas producers, the sole licence for the Weardale patent furnace, &c. Mr. C. G. Norris has accepted the position of general manager, and Mr. Thos. Wright that of works manager.

Messrs. E. P. Allam & Co., of 11, Red Lion Street, Clerkenwell Road, E.C., have recently opened a department for the repair of dynamos and motors.

A private company, named Erith's Engineering Co., Ltd., with a capital of £30,000, has been formed to acquire the patents, goodwill and pending contracts of the existing Erith's Engineering Co., and to carry on the business. The directors will be Messrs. Charles, George and Henry George Erith; all necessary working capital will be subscribed by them and their friends, and no shares will be offered to the public. The address will remain the same, and no change in the staff and agencies is contemplated. Mr. Percy Dupont Simmons will be secretary, and Mr. Thomas Black auditor.

Mr. E. T. Oubridge has been appointed sole agent for cables, &c., for London and South Coast for Messrs. I. Frankenburg and Sons, Ltd., Salford, Manchester.

Catalogues, Lists, &c.—Positive Rotary Pumps, Ltd., 23, Northumberland Avenue, W.C. Illustrated card showing various forms of rotary pumps (not centrifugal), several of which are electrically driven.

Richardson Electrical Co., Ltd., 16, Dorset Street, Baker Street, W. Leaflet showing two handsome electroliers.

H. B. Brooks, Granville Works, Tennant Street, Birmingham. Price list of patent differential "Fool-proof" motor-starting rheostats.

General Electric Co., Ltd. Pamphlet relating to pocket and hand electric lamps, fitted with primary batteries. The batteries can be had separately, and do not deteriorate in stock.

Mason's Gas Power Co., Ltd., Alma Works, Levenshulme. Illustrated brochure on gas producers (Duff-Whitfield patents) for bituminous coal, suction gas plants, &c. The leading types of British gas engines are illustrated, numerous sections and diagrams of gas plants are shown, and much useful information on gas power in general is given, the brochure being admirably produced.

Electrical Power Storage Co., Ltd. A neat little pocket catalogue, the pages being reproductions of the company's larger lists relating to lighting and traction cells, &c., with particulars and prices of cells and accessories, and sectional paper for notes.

E. Brook, Threadneedle Street, Market Street, Huddersfield. Pamphlet relating to the E.B.H. single-phase a.c. motors and starters, giving dimensions and prices. The motors are made from ½ h.p. to 10 h.p.

Veritys, Ltd. Pamphlet describing the Verity-Gott two-voltage or series-parallel controller, which gives continuous acceleration from rest to full speed, and delicate adjustment at any point in its range. The controller can be made for series, shunt, or compound-wound motors, and the change from one voltage to the other, when two voltages are used with one motor, or from series to parallel where two armatures are used with one voltage, is made imperceptibly by the continuous movement of the controller handle.

General Storage Battery Co., 42, Broadway, New York. Catalogue "A" of Bijur storage batteries, "High-duty" type for stationary service, handsomely illustrated, and containing dimensions and prices of the cells.

British Thomson-Houston Co., Ltd. Pamphlet No. 181, superseding Nos. 140 and 159, and illustrating continuous current motors and generators, type "D A." The nomenclature of the Engineering Standards Committee is adopted, the machines being either "protected," "ventilated," or "totally enclosed." Automatic belt-tighteners for short drives, geared motors, &c., are shown, with full details of dimensions and prices.

Oxford University Lighting.—The following electric lighting work is to be carried out during the long vacation at Oxford, under the supervision of Mr. Morgan Williams, M.Inst.C.E., consulting engineer to the University:—The Indian Institute and University Museum (contractors, Messrs. Hill, Upton & Co.); the Bodleian Library (camera) (Messrs. W. A. S. Benson & Co.); new examination schools (extensions) (Messrs. Lucy & Co.).

Liquidations.—Notice is given of intended dividend in the case of J. W. Hunter, of 8, Norwood Road, Leeds, electrical engineer and motor-car dealer. Last day for receiving proofs, July 17th. Trustee, W. H. Platts, 1, Oxford Row, Leeds.

A first meeting of creditors and contributories is announced in the case of the Garcin Renault Electric Cars and Accumulators, Ltd., 5, 6 and 7, Denman Street, London, at 33, Carey Street, July 11th, 11 and 11.30 a.m. respectively.

Creditors of the Electro-Sulphur and Light Syndicate, Ltd., are required before August 12th to send particulars of their claims to Mr. E. T. R. Wilde, 61½, Fore Street, E.C., the liquidator.

Port Elizabeth (S.A.).—The new Harbour Board offices were opened on the 2nd ult. These offices are the finest yet built in Cape Colony, nearly all the internal decorations being of antique style. They are also well lighted by electricity and ventilated by fans, while all the principal rooms are connected by telephone. All the wires and cables have been drawn into steel insulated conduit pipes, and all the electroliers in the principal offices have been made specially to match the antique metal of the different rooms. The centre electrolier fixed in the board room was made of hammered copper representing ships in full sail, sunrise, &c.; this fitting was specially designed and made by Messrs. Thursfield and Co., Hatton Garden, London. The ventilation by motor fans has been well planned out by the architects, Messrs Jones and McWilliams, Port Elizabeth, air-shafts in the walls being taken from the different rooms to the roofs, where the exhaust fans are fitted; the result is very successful, as the rooms are kept very cool without inconvenience to the occupants.

The telephone system which is installed is one of the most complete in the colony, intercommunication service being provided for each office, while the heads of departments have also secret service to each other. Provision has also been made for each office to have communication with the proposed Harbour Board Exchange, which is to connect all the workshops, jetties and outlying offices at a later date. The Berliner Telephone Co., of London, supplied special instruments of the magneto type for this work. The entire installation has been laid down without joints being made in any part of the wiring, and a plan showing the positions on each floor of the pipes, telephones, inspection boxes, &c., has been provided by the contractor. The insulation resistance of the wires and cables in use for the electric light, measured by the Harbour Board's electrical engineer, was nearly double the requirements of the British Fire Assurance rules.

Antique electroliers were supplied by Messrs. Thursfield & Co. and the Edison & Swan United E.L. Co.; wires, cables and insulated steel pipes by the British General Electric Co., Cape Town; switchboards by Messrs. Spagnoletti & Co., of Shepherd's Bush;

telephones by the Berliner Telephone Manufacturing Co., London; motor-fans by Messrs. Blackman & Co., London. This important contract was carried out by Mr. A. G. KNIGHT, electrical engineer and contractor, Port Elizabeth.

Book Notices.—*American Street Railway Investments* (the Electric Traction "Red Book") for 1905, has just been issued by the McGraw Publishing Co., of 114, Liberty Street, New York, publishers of the *Street Railway Journal*. This is the twelfth annual edition of this manual, and is the recognised authority on financial statistics of American street railway companies. The book contains 415 pages of statistical matter, and is 53 pages larger than the edition of 1904, due in part to the addition of reports from new roads, and largely to the fact that more companies have furnished a statement of their earnings this year. Among the new features in the manual this year is an increase in the index, which is bound in the back of the book. As usual, the introduction to the book contains a summary of the gross receipts for the last two years of the principal companies reporting. As there were many incorporations during 1904, this table is not an exact index of the growth of business, as the figures in a number of cases represent receipts for a larger mileage. Nevertheless, the increase is such a steady one as to indicate a substantial gain in street railway earnings for the past year. The price of the annual is $5.00.

"Magnetism and Electricity for Students." By H. E. Hadley. London: Macmillan & Co. 6s.

"Report of the Council to the Members of the City and Guilds of London Institute, 1905." London: Gresham College, E.C.

"Physical Review," Vol. XX., No. 6, June, 1905. Lancaster, Pa., and London: Macmillan & Co.

"Proceedings of the American Institute of Electrical Engineers," Vol. XXIV., No. 6, June, 1905. New York: The Institute, 95, Liberty Street.

"Annual Report of the Commissioner of Patents of the U.S. for the Year, 1904." Washington: By Authority.

"Record of Transactions of the Junior Institution of Engineers," Part 1, Vol. XV. Address by the President, W. H. Lindley, F.G.S., on "Municipal Engineering on the Continent." London: The Institute, and Percival Marshall & Co.

"Notes on the Induction Motor as Generator." By T. P. E. Butt. Paper read before the South African Association of Engineers, Johannesburg.

LIGHTING AND POWER NOTES.

Australia.—MELBOURNE.—The gross revenue of the electricity undertaking for the year ended February 28th last amounted to £69,585, and the working expenses to £34,741, leaving a balance of £34,843. Interest charges amounted to £13,395, £3,615 was put to sinking fund, and £7,230 to depreciation and renewals; the net profit amounted to £10,601. The year was started with a debit balance of £1,241, so that a surplus of £9,360 is available. An additional £2,000 is to be set apart for depreciation and renewals, making the total contribution to that fund for the year £9,230; the depreciation and renewals account now stands at £21,461. The cost of changing over the installations—from overhead to underground—was £25,555, which was charged against capital. The Committee has provided for the payment of £6,000 out of the surplus on account of this expenditure, and £1,000 is to be set apart as a contribution to the town funds.

The business done has grown steadily during the year. The demand for lighting by private consumers was very satisfactory, the consumption for this purpose having increased. The units sold amounted to 1,915,185, as against 1,764,097 in the previous year. The demand for power and heating purposes showed an increase of 76·9 per cent.—a rise from 351,472 units to 621,829 units. The number of motors connected at February last amounted to 508, equivalent to 1,326½ H.P. The price of energy for heating and power was reduced from 3d. to 2d. a unit. The principal items of expenditure during the year were extensions of buildings, £8,658; additional boilers, mechanical stokers, coal bunkers, conveyors, &c., £10,463; mains, £5,413. The total revenue showed an increase of £4,738. The works expenditure decreased by £525, although the output increased by 468,646 units.

The following reductions in the charges for lighting were recommended as from June 1st: Flat rate, from 5d. to 4½d. per unit; max. demand system, from 8d. and 2d. to 7d. and 2d. per unit. Arc lamps: seven nights, till midnight, £22 per annum to £20 per annum; six nights, till midnight, £20 to £18; till 9.30 p.m. and till midnight on Saturdays, £17 to £15 10s. per annum; burning five nights till 9.30 p.m. and till midnight on Saturdays, £15 to £13 10s.—*Australian Mining Standard.*

SYDNEY.—The City Council proposes to absorb two private electric lighting companies, and a resolution authorising the engineer to enter into negotiations with the companies as to the terms of purchase has been carried.

Negotiations have been completed between the City and Paddington Councils for extending the electric light to Paddington.

Birstall.—About six months ago the B. of T. wrote to the Council, stating that unless some action was taken the E.L. order would be revoked. The Council, owning the town gas works, feared that if a private electricity company were allowed to come in the gas profits might be seriously affected, and, on the other hand, it was not prepared to go to the expense of putting down an electricity plant. Negotiations have now been concluded with the Yorkshire Electric Power Co. for a bulk supply for 15 years. A distributing station is to be erected, and application will be made to the L.G.B. for sanction to borrow £2,000 to carry out the work.

Beaconsfield (S.A.)—In the Cape Legislative Council the Hon. W. Ross, in moving the second reading of the Beaconsfield E.L. Bill, explained that its object was to enable the residents to obtain a supply of electricity from De Beers. The price would be 6d. per unit. The second reading was passed.

Cardiff.—The Lighting Committee proposes to erect, at a cost of £2,200, a sub-station in Cathays Park, to be exclusively used for the distribution of electric lighting and power within the park.

Caterham.—Owing to the increased demand for energy, both for lighting and power, the Urban Electric Supply Co. has found it necessary to extend the plant at its Caterham Valley works. A new water-tube boiler, with mechanical stokers, and a 120-H.P. steam set is to be put down. These will be supplied by Messrs. Babcock & Wilcox, Belliss & Morcom, and the G.E. Co. Considerable mains extensions are also to be put in hand. The whole of this extension work is being carried out under the company's resident engineer, Mr. F. Bruton.

Clydebank.—Messrs. John Brown & Co., shipbuilders, Clydebank, are now equipped with a complete electric power installation. This has been recently inaugurated, and will take the place of steam power, which has hitherto been used for driving purposes. Some years ago the company started a power station with gas engines on a small scale, but so planned as to be capable of extension to any capacity. The experiment proved very successful, and gradually the plant has been extended, until now it is sufficient for all the work of the engine and boiler shops.

Continental Notes.—SPAIN.—A concession has been applied for, to put down a water-power plant on the Pineda River (Burgoss) to supply energy for lighting and power purposes.

ITALY.—La Società Idro-Elettrica Alessandria has just been formed at Alessandria, with a capital of £44,000, to undertake the electric lighting of the town.

Coventry.—The annual report of the Corporation E.L. undertaking for the 12 months ended March 31st, 1905, states:—The capital to date is £134,504, against £119,471 in the previous year. The amount raised on loan is £149,875, while other receipts on capital account have amounted to £1,776. The amount of capital repaid is £29,000, and the sinking fund amounts to £12,032. During the year the number of consumers increased from 536 to 637, and lamps connected from 53,746 (8 C.P.) to 71,727. The number of units sold increased from 920,192 to 1,375,735; the total revenue from £10,844 to £13,248; working expenses were £5,031, as against £4,599 in the previous year; leaving a gross profit of £8,217, against £6,246 in 1904. Capital charges amounting to £8,812, the net result was a loss of £229, against a profit last year of £776, and a loss the year before of £189. There is a balance in the hands of the treasurer on net revenue account of £1,625, and the Committee has recommended that the deficit be paid out of that amount, and the balance of £1,396 carried forward to next year's account.

Dudley.—The total revenue of the Corporation electrical undertaking for the year ending March 31st was £10,707. The gross profit amounted to £5,170, from which sum £2,071 has been set aside for interest and £2,067 for sinking fund. There is a net profit for the year of £693. The total expenditure now amounts to £77,562.

Durham Collieries.—The Lambton Collieries, Ltd., who recently decided to introduce electricity on an extensive scale for pumping, hauling, coal-cutting, and lighting purposes at their collieries, have placed the contract for the necessary plant with the A.E.G., of Berlin, and Messrs. Bruce Peebles & Co., of Edinburgh, at a cost of about £26,000. The Burn Moor, Lady Ann, Lumley, Newbottle (Dorothea and Margaret), and the New Herrington pits, as well as the Lambton Co.'s brick and tile works at Philadelphia, are to be equipped. Power will be taken from the Durham Electric Power Co.'s station at Philadelphia, which in the course of a short time is also to supply energy for pumping and hauling purposes at the Eppleton, Lyons and Elemore pits of the Hetton Coal Co. The electrical supply will be three-phase 50 cycles at 6,000 volts, and will be conducted by six lines about two miles to the pits, and there transformed to a working pressure of 500 volts; the lighting pressure will be 110 volts. The underground cable is to be three-core, lead-covered, paper-insulated, and double armoured. Most of the motors for mining purposes will be gas proof. Motors for pumps, fans, and air compressors are included in the contract. Two of the turbine pumps will deliver 700 gallons of water per minute against a head of 588 ft.

Fenton.—The B. of T. having asked the U.D.C. what steps had been taken to carry out the E.L. order of 1899, the Council has replied that it has come to the conclusion that the demand for energy in the district would not warrant the expenditure of providing works.

Glasgow.—The Clyde Navigation Trustees have given permission to the Clyde Valley Electrical Power Co. to lay a temporary cable across a river at a point outside the statutory limits of lateral deviation.

Heavitree.—Exeter T.C. has decided to apply for a prov. order to enable the Corporation to supply energy to Heavitree, and the U.D.C. at the latter place has given the necessary consent. It was originally intended that Heavitree should obtain the order and lease it to Exeter for 21 years, but the B. of T. declined to sanction such a course.

Hebden Bridge.—The report on the past year's working of the U.D.C.'s electricity undertaking shows a gross profit of £37, and a deficit to be met out of the rates, of £459.

Ilford.—With the object of increasing the number of consumers of energy, the U.D.C. has decided to appoint a canvasser at a salary of £2 per week and commission.

Jamaica.—According to latest mail advices, the Jamaica *Daily Telegraph* announces that the arrangement entered into with the debenture, preference and ordinary shareholders of the Jamaica Electric Light and Power Co. for the taking over of that concern by the West India Electric Co. has been ratified in Canada, and a circular has been issued for scrip to be lodged with the Colonial Bank. The majority of shareholders have decided to take cash for their shares instead of shares in the new concern.

Jubbulpore (India).—Messrs. Kilburn & Co., of Calcutta, have applied for a licence to supply energy for "electric traction and to the public for all purposes" within the Cantonment of Jubbulpore in the Central Provinces. The system of supply to be used is specified in such a manner as to leave the promoters practically free to put in whatever they please.

Leyton.—The U.D.C. has been asked to give lighting consumers the option of a flat rate, or rebate system of charging.

The accounts of the E.L. undertaking for the past year show a net profit of £1,444.

London.—SHOREDITCH.—The accounts of the electricity supply department for the year ending March 31st last, show a gross profit of £17,275 (after allowing for bad debts), which is equal to 5·5 per cent. on the average capital invested, and after meeting financial charges, and change of pressure expenses, a surplus of £1,230 remains. £1,000 of this is to be credited to the reserve fund, and the balance is to be carried forward. The electricity department is charged only the value of the steam supplied by the destructor; the net cost being borne out of the general rate. The expenditure incurred in the change of pressure of supply has been spread over a term of five years at £1,500 per year. The Bethnal Green B.C. has asked Shoreditch if it would be prepared to supply the former with energy in bulk, and the borough electrical engineer has been instructed to report terms at which such supply could be given.

L.C.C.—The Parliamentary Committee reported that an adjourned meeting was held on the 5th ult. of the conference of representatives of the Council, the City Corporation and the borough councils to discuss the action to be taken in regard to the Power Bills. As a result, resolutions were passed to the effect that such Bills as those of the Administrative County of London and District Electric Power Co. and the Metropolitan Electric Supply Co. should be strenuously opposed; and that the L.C.C. be requested to arrange for a deputation to wait upon the President of the Board of Trade to urge members of Parliament to strongly oppose the motion for second reading, and to communicate with the various authorities throughout the country with a view to organised opposition being made to the Bills. The committee stated that steps were immediately taken to give effect to the resolutions.

At the meeting on Tuesday, it was decided to sanction the borrowing by Islington Borough Council of £4.885 for electric lighting works, to advance £15,304 to the same Council for installation and meters, and to lend £900 to the Stoke Newington Council for the acquisition of a site for a transformer station.

MARYLEBONE.—The reinstatement of the trenches after the laying of the E.L. mains appears not to have been done well enough by the contractors to satisfy the Council. An independent surveyor was called in on the suggestion of the E.S. Committee, but his views did not meet those of the B.C. surveyor. The Works Committee states that it will claim against the Electricity Department for its expenses in this matter, and has also decided to engage a qualified person to supervise the reinstatement work and to charge the cost to the latter department.

Owing to change of pressure of supply, some days' delay may ensue in endorsement of insurance policies, and, in view of the risk, the E.S. Committee has taken up a temporary floating loan to the extent of £100,000 at Lloyds to cover any liability. About 40 consumers object to the change of pressure. The Committee has made formal application to the B. of T. for sanction to the change without the consent of these consumers, but the Board proposes holding a formal inquiry into the matter.

SOUTHWARK.—The City of London Electric Lighting Co. has asked the B.C. if it might quote for a supply of electricity to the Council in bulk, it having been reported that the latter might consider such an offer. The company's area of supply, however, does not include that of the Council, and therefore no action has been taken in the matter.

The County of London Electric Supply Co. has written stating that it is prepared to submit proposals for dealing with the electric lighting undertaking of the Council on either of the following alternative bases:—(*a*) To supply energy in bulk for distribution by the Council at a price cheaper than it can be generated at by the Council; and (*b*) to take over the undertaking on lease, and work it for a period of years, guaranteeing a sum sufficient to provide sinking fund and depreciation on the capital expended. The matter is to be considered by the General Purposes Committee.

Mexico.—The Mexican Light and Power Co., a Canadian concern which is completing a large power plant at Nexaco, has acquired the plant and businesses of the Mexican Gas and Electric Light Co. and the San Ildefonso Electric Light Co., and now controls the electric lighting and power supply in the city of Mexico.

Mitchelstown.—Local residents urge the raising of a loan for the lighting of the town by electricity, in accordance with plans and specifications prepared by Mr. G. Marshall Harris, of Carlow.

Norwich.—Messrs. J. and J. Colman, Ltd., have resolved to take a supply of energy from the Corporation mains for use at their works. It was stated recently that the Electricity Committee had accumulated a surplus of about £6,000, but it recommends that this should be retained, and no surplus profit should be applied, at present, in reduction of rates.

Sunderland.—The Assessment Committee has reduced the rateable value of the Corporation Electricity Works from £6,500 to £5,580.

Tunbridge Wells.—A proposal was to be made at Wednesday's meeting of the T.C. that it is desirable in the interests of the ratepayers to dispose of the Corporation electricity undertaking to a company, in order to obviate further capital expenditure, and in view of the disadvantages of the control of the undertaking by the municipality. Evidently the telephone fiasco is fresh in the memories of the residents.

Walthamstow.—The L.G.B. has sanctioned the borrowing of £1,500 for mains extensions.

Walton-on-Naze.—The Coast Development Corporation has informed the Council that it intends applying for electric lighting powers for the district.

Willesden.—The Council's consulting electrical engineer has suggested that owing to the low rate at which energy is purchased for public lighting, an additional 50 arc lamps might be erected without further charge, and upon this a scheme for public lighting extensions is to be drawn up. Draft agreements have been submitted to the Council for the hire-purchase or simple hire of motors, and the resident engineer has been instructed to obtain particulars of the probable demand for them, and what charges should be made; it is anticipated that the maximum demand at the end of the present year will total between 650 and 700 KW. The Electricity Committee has accordingly instructed the consulting electrical engineer to obtain quotations from the British Westinghouse Co. for the supply of an additional 250-KW. machine for its distributing sub-station, or for replacing the present plant and substituting two 300-KW. and two 150-KW. sets.

Wilmslow.—The new street lighting scheme will soon be completed. The whole of the cable has been laid, covering a length of about 15 miles.

Wimbledon.—Commencing on the 1st inst. the Council has decided to supply energy for driving motors of 2 H.P. and over at 1½d. per unit, but the charge for motors under 2 H.P. will remain at 2d. per unit. Meter rents are also reduced to 1s. per quarter. Sanction to another loan of £5,000 for E.L. purposes is also to be applied for.

Yarmouth.—On June 29th a L.G.B. inquiry was held into the application of the T.C. for a loan of £10,000 for E.L. purposes. There was no opposition.

TRAMWAY AND RAILWAY NOTES.

Birmingham and Midland Tramways.—The total revenue for the year of the above company amounts to £108,626, and there is an available balance of £20,951, with which it is proposed to pay a dividend of 5½ per cent. on the preferred ordinary shares and to carry forward £1,701. The traffic recipts have suffered by reason of the reconstruction of the lines for electric traction. This work has, however, now been completed, and the receipts have materially increased. The expenditure on capital account during the year amounted to £160,913, including outlay on the reconstruction of lines, the erection of a power-house and transforming stations, the purchase of cars, &c. The number of passengers carried during the year was 8,504,584; the average receipts per passenger, 1·26d.; and the average expenditure per passenger, apart from line, rent, &c., ·76d.

Cairo.—The Belgian Société des Tramways du Caire has concluded a fresh convention with the Egyptian Government for the construction of new lines and extensions, and for the doubling of the tracks. It is proposed to pay £50,000 to the Government as the company's share in the expenditure on the erection of bridges over the Nile, in order to facilitate the connection of the Pyramids line with the urban network, and in return the concessions have been extended for a period of five years—that is, until the end of 1951. The share capital is to be increased from £240,000 to £400,000 by the emission of 8,000 £20 preference shares, and an issue of 4 per cent. bonds to the extent of £100,000 is also to be made. M. E. Empain, and a group associated with him, have been declared concessionnaires of an electric railway and two tramways, which they are engaged in establishing in the Desert of Abbassieh to serve the Oasis. It is intended to form for this undertaking a separate concern under the title of the Compagnie des Chemins de Fer Electriques et Tramways des Oasis, with a share

capital of £500,000, capable of being increased to £1,000,000. The lines conceded are a railway from Pont Simoun to the Oasis, a tramway from the same starting point to the Djellah-Racha street and a tramway connecting the Abbassieh tramway and the Oasis.

Continental Note.—PARIS.—The State Council has granted a concession, for which application was made several years ago, for the construction of an underground electric railway between the north and the south of Paris. The length of the railway, which will connect Montmartre and Montparnasse, will be seven miles, and it is expected that three years will be occupied in its construction. As portions of the line will be built at a considerable depth, the obligation has been placed upon the concessionnaire company to provide lifts at all stations which are lower than 40 ft. from the street level. The stations, which will be built in the vicinity of existing stations of the Metropolitan Railway, are to be connected with the latter by means of underground passages so as to facilitate the transfer of passengers from one line to the other. It is estimated that the cost of construction will amount to £2,800,000. This sum will be provided by the company which will both construct and work the line, the concession for which will expire simultaneously with that for the third network of the Metropolitan Railway, when the former's whole line, equipment and accessories will pass into the possession of the Paris Municipal Council. The latter, however, has the right of purchase at any time. The company will be required to pay to the Council 1 centime for each passenger ticket issued, in so far as the annual number does not exceed 30,000,000. Above this total the payment will be 2 centimes for 15 and 20 centime tickets, and 2½ centimes for 25 centime tickets. In addition, the town will receive one-half of the income from advertisements.

Folkestone-Hythe.—A conference of representatives of Folkstone and Hythe Corporations, and the Sandgate and Cheriton U.D.C.'s was held last week, when it was decided that there was a necessity for a system of electric tramways to connect the four districts. It was further resolved that the authorities should work together in the matter of negotiating for tramways.

Great Yarmouth.—An extension of the Great Yarmouth municipal electric tramway from Southtown to Gorleston was opened for service on Tuesday, by the Mayor. The line was originally laid as a horse tramway in October, 1872. In 1903 it passed into the hands of the British Electric Traction Co., Ltd., from which the T.C. purchased the line at a price fixed by arbitration at £15,000. It was considered advisable to relay the line, and a double track was also laid from Yarmouth Bridge along the route to the Half-Way House. Cars identical with those already running on the Yarmouth municipal system were supplied by the Brush Electrical Engineering Co. at a cost of £5,646. Overhead equipment was supplied by the British Electric Equipment Co. for £2,357; and Messrs. J. Dennis & Co. took a contract for rail bonds at £480. Passengers will be carried from the Southtown terminus to Gorleston for 2d., instead of 3d. as hitherto.

Leyton.—The T.C. has appointed a sub-committee to consider the purchase, and the taking over of the Lea Bridge, Leyton and Walthamstow Tramways Co.'s undertaking.

Liverpool.—The stator of the last of the four 6,000-volt three-phase induction motors which the British Thomson-Houston Co. has been supplying for the principal sub-station in Fairclough Lane, Liverpool, was received recently. The motors are of 790 H.P. each, with a frequency of 50 cycles, and run at 292 r.p.m. The first two motors of the four covered by the order in question were delivered in November last, and have been in use for some time. Each motor drives a 500 to 550-KW. generator. Four more induction motors of the same capacity as those named above, but of somewhat different design, are about to be supplied by the B.T.-H. Co. for the Paradise Street generating station, Liverpool. All of the above machines are, or will be, hand-wound. The company has also erected a large switchboard at the Fairclough Lane station. This board has 10 panels, with black enamelled slate front, and carries no high-pressure gear.

The traffic on the West Derby and Old Swan tram routes has become very heavy, and, in order to relieve the congestion, a new belt service between the Old Haymarket and Sheil Road *via* Kensington and West Derby Road alternately is being tried as an experiment, the fare being 1d. either way.

Liverpool Overhead Railway.—On Sunday the connection made between the Seaforth Sands terminus of the Liverpool Overhead Railway and the Lancashire and Yorkshire Railway, Liverpool-Southport line at Seaforth was operated for the first time, when a large number of persons made the journey to Southport from stations on the overhead railway. No through trains are possible as yet, owing to the different arrangement of track on the two lines, the overhead railway being worked by a "live" middle rail, and the Lancashire and Yorkshire Railway by the four-rail system. It is, however, intended to adopt trains which will be able to traverse both systems, and thus afford a through service. Therefore, the present time-table is purely experimental, and modifications and improvements will be made as required.

London.—(L.C.C.)—The Highways Committee stated that the Islington Borough Council had approved the introduction of the overhead system on the tramways from the Archway Tavern *via* Archway Road to the county boundary at Highgate Archway, subject to the details of the work being agreed between the officers of the Council and of the Borough Council. The decision of the local authority was communicated to the Board of Trade, and the latter sanctioned the system, subject to any requirements which might be necessary on the inspection of the completed works, and at any time for the protection of the Government observatories and laboratories. It was, however, stipulated by the Board that electrical energy should not without its consent be supplied through the feeders at a pressure higher than 650 volts.

An expenditure of £1,000 was sanctioned for the provision of additional cranes at the New Cross car-shed, and £780 for the wiring of the Streatham car-shed.

The Highways Committee suggest the expenditure of £13,500 for constructing and fitting roof-covers to 150 of the electric cars on the Council's tramways. Already 160 covered cars are either in use or under construction. It is recommended that the covers shall be made and fitted at the Council's own car works.

Metropolitan District Railway.—It was very unfortunate that the opening of the electric service on the Underground Railway on Saturday last should have been marred by a flood, which rendered it necessary to withdraw the electric trains for a time; the flood occurred in the same place as on previous occasions—namely, in the hollow at Hammersmith, the sewers being unable to cope with the sudden influx of water following a heavy fall of rain. The traffic was entirely disorganised, and great inconvenience was caused to business people.

On Sunday morning the electric service was resumed, and has continued since then. Great delight was manifested by the public in the showers of sparks emitted from the contact shoes, due to the variable contact with the rough surfaces of the conductor rails, but as the latter become smoothened by wear this entertainment will lose its attractions.

Attempts were made to inaugurate the electric service on the Inner Circle, but it was found necessary to postpone the running for a few days in order to carry out further adjustments in connection with the arrangement of the contact shoes.

North Shields.—As two men named Buck and Leighton were walking near the electrified branch of the North-Eastern Railway, near North Shields on Sunday, the former stepped on the "live" rail. He immediately fell to the ground, and came in contact with the live rail. Although Leighton also received a severe shock, he at once jumped to his friend's assistance, and succeeded in lifting him free from peril. Buck was placed in a passing car and taken to the Tynemouth Infirmary suffering from shock and severe burns about the hands and feet.

Poole-Bournemouth.—The inauguration of a through service between Poole and Bournemouth, and the official celebration of the purchase of the Poole tramways by the local governing bodies at a cost of over £100,000, took place on Monday. The members of the Bournemouth Corporation and the Branksome U.D.C. were conveyed over the route in gaily-decorated cars, and were met at Poole by the Mayor and Corporation of that town.

Rochdale.—The conversion of the Rochdale tramways from steam to electric traction has now been completed. The B. of T. inspection of the two new sections in the borough was to take place on Tuesday last, and arrangements have been made for a frequent service of cars.

St. Helens.—The solicitors of Mrs. Williams, widow of the Prescot Union workhouse master who was recently killed while on a tramcar near Rainhill Bridge, have made a claim against the St. Helens Corporation Electricity Committee on the ground that the accident was caused by the overhead equipment belonging to the Corporation being defective. After considering the matter, the town clerk was instructed to write repudiating all liability.

South Africa.—DURBAN.—The tramway manager, Mr. H. N. Thomas, reports that during May the revenue of the department amounted to £7,431, an increase of £116 over the same period of last year. The mileage for 1905 was 94,734, and the revenue per car-mile, amounted to 18·76d. A re-adjustment of tram fares is to be presented to the Council at their next meeting; a cash system is now proposed in place of the present coupon system.

BLOEMFONTEIN.—The matter of the tramway concession at Bloemfontein seems to be the cause of much ill-feeling, and the *Bloemfontein Post* for June 7th contains affidavits by Mr. H. F. Gill, a prominent Bloemfontein citizen and chairman of the Chamber of Commerce; Mr. Otto Lenz, of the firm of Rennert & Lenz, electrical engineers, Johannesburg; Mr. Charles G. Fichardt, of the firm of Fichardt & Daniels, Bloemfontein; and Mr. Alfred Clarke, electrical engineer, Johannesburg, tending to show that in the matter of the electric tramways' concessions in Bloemfontein, other tenderers than Messrs. Davies & Spain were not fairly treated. The *Post* now urges the holding of an indignation meeting.

Whitefield (Lancs.).—The U.D.C. has applied to the B. of T. for a further prolongation of the periods for the commencement and completion of the tramways, the former to August 6th, 1906, and the latter to August 6th, 1907.

Willesden.—At the meeting of the U.D.C. on Tuesday, the town clerk reported the result of the conference convened by the Council in reference to the claim of the Metropolitan Electric Tramways Co. to pay rates levied under the Public Health Acts on one-fourth part of the net annual value of the light railways or tramways leased by them from the Middlesex County Council. It was resolved that proceedings be taken to test the case in a court of summary jurisdiction.

THE NEW ELECTRIC POWER HOUSE AT DETROIT, MICHIGAN.

The Detroit Edison Co. has quite recently built a large electric generating station at Delray, 3½ miles from the city of Detroit, Michigan, which, being equipped with vertical steam turbines coupled direct to generators supplying three-phase current at 60 cycles, 4,600 volts pressure, has many points of interest to the electrical engineer on this side.

Fig. 1.—View of the Detroit Edison Co.'s Power Station at Delray.

The demand for electrical energy for both lighting and power purposes in Detroit had reached such proportions some three years ago that it was found necessary to build an entirely new station on a large scale. At that time there were four electricity stations in Detroit, supplying both direct and alternating current at various voltages.

Appreciating the need for a reorganisation of the electric supply undertakings in the city, two of the companies entered into negotiations for acquiring land adjoining their stations to take new generating plant, but before these schemes were carried into effect, a project was put forward by Mr. W. F. White, of New York, for the construction, in the "salt lands," some little distance from the city, of a large generating station, which would supply energy in bulk to the two companies specially interested, and to any others who would purchase energy in large quantities, also to produce salt, which abounds in the neighbourhood, by forced evaporation. Mr. White's scheme was, after consideration, adopted, and the Detroit Edison Co. was formed to carry out the plans.

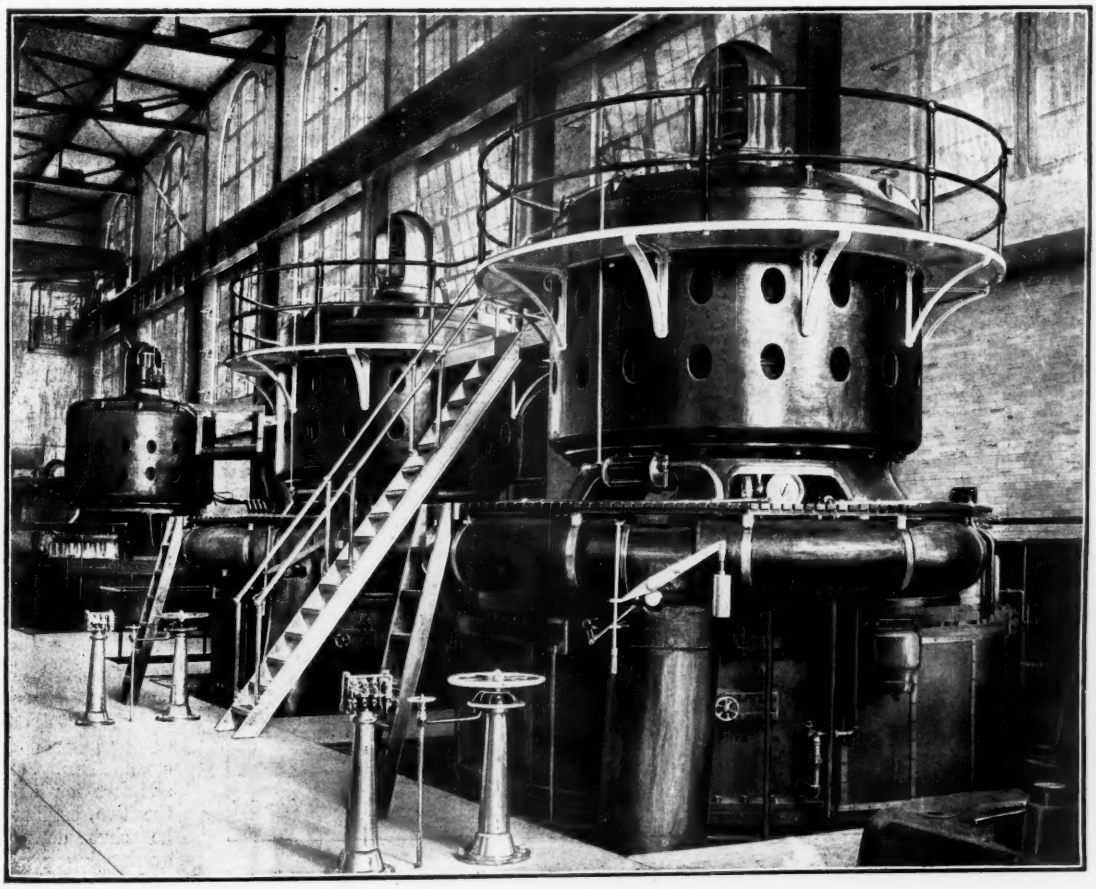


Fig. 2.—Interior of Engine Room, showing the 3,000-kw. Curtis Turbo-Generators.

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The station has now been completed, and is supplying energy to the Edison Illuminating Co., the Peninsular Electric Light Co. and the Detroit United Railway. The company will supply none but wholesale purchasers of electrical energy, thus not competing in any way with persons or companies supplying current to small users and private consumers.

Messrs. Westinghouse, Church, Kerr and Co. were selected as engineers for the undertaking, and were instructed to prepare reports and plans embracing several schemes, and, after having given due consideration to the question of the best location for the power house, the cost of electric transmission, the future needs of the city, the salt project, the cost of property, facilities for the delivery of coal and for shipments of salt, a 30-acre tract at Delray was selected, which gave ample room for the carrying out of the selected scheme and for future extensions on a large scale. It was decided to install plant having a total capacity of 12,000 KW., this being deemed sufficient to deal with all probable requirements up to the end of 1906. It is probable that before that date another station of similar design and arrangement will be under construction.

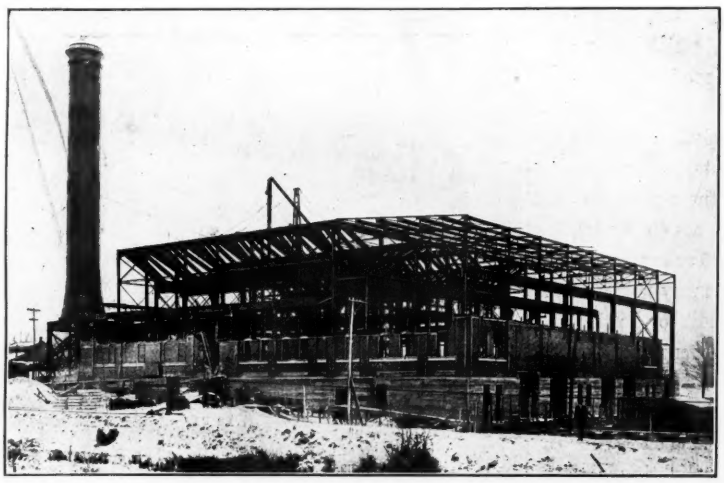


Fig. 3.—The Power House Under Construction.

Below the boiler and engine room floor-line, concrete has been used entirely, the footings being carried down to the blue clay bottom well below the extreme low-water level of the river. Above the main floor-line the walls are of red brick and steel, curtain walls being used between the steel columns. Reinforced concrete has been used in the construction of the floors and roof, Kahn bars being used throughout to reinforce the concrete work, thus rendering the building fireproof throughout. In the boiler house are installed 24 boilers of the Stirling Co.'s manufacture, each having 4,834 sq. ft. of water-heating surface, and 2,000 sq. ft. of superheating surface, steam being delivered at a pressure of 200 lb., superheated 200° F. Each of the four turbines is fed by six of these boilers, and this allows for an ample supply of steam. By slightly overrunning the remaining boilers, one out of each battery of six may be shut down for examination or repairs, without affecting the output of the unit to which it is attached.

The combined boiler and superheater units are so arranged that each unit can be used as a boiler having 6,834 sq. ft. of water heating surface, or as a combined boiler and superheater, in which case a regulator is provided for adjusting the degree of superheat in the steam delivered; this can also be regulated by the use of spray piping, which introduces water into the lower superheater drum.

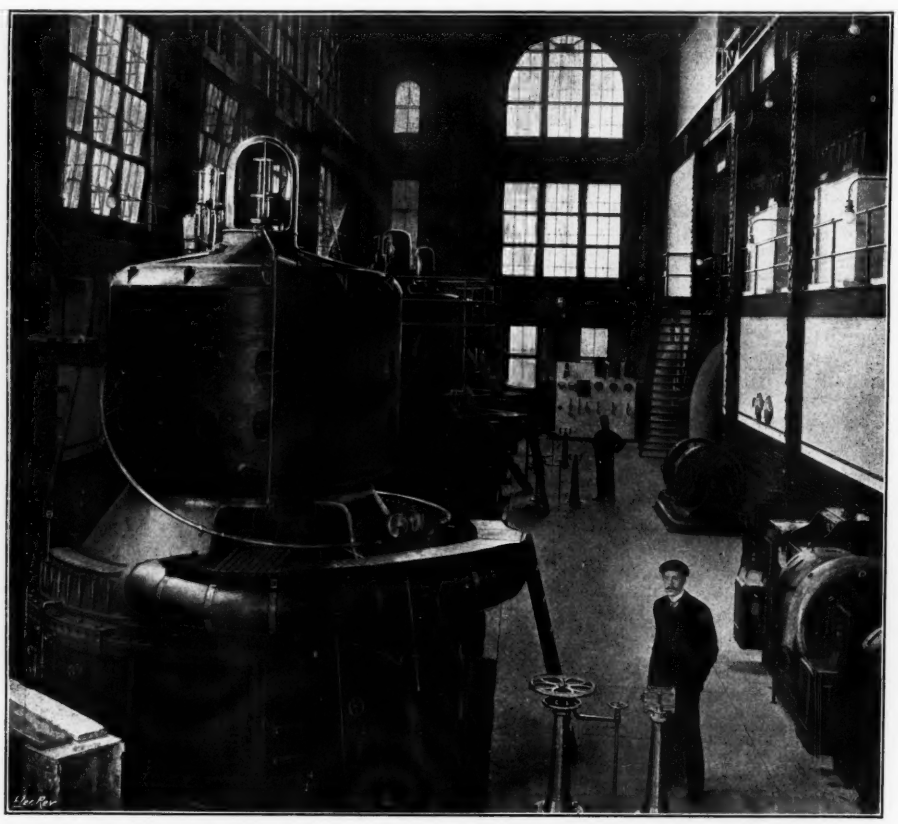


Fig. 4.—View of Engine Room, Showing Switch Galleries.

The boilers are equipped with Roney mechanical stokers, coal being supplied to the latter by gravity, from overhead bunkers, the ash and clinker being delivered into a hopper again by gravity.

The 12 stokers under each battery of six boilers are operated by two steam engines, and each engine can operate all of the 12 stokers in the row, or half that number, or any other desired combination, thus allowing for one of the two engines to be shut down for overhauling or repairs without affecting the stoking.

Both natural and induced draught are provided for. There are three steel chimneys lined with red firebrick throughout, and these are 132 ft. high. Two have an internal diameter of 11 ft., while the third measures 16 ft. across inside. These stacks provide the necessary draught to operate the boilers at about three-quarters of their rated capacity

with the economisers cut out, and when the economisers are in operation at about one-quarter of their rated output. The mechanical draught equipment consists of four fans, each 15 ft. dia. by 6 ft. 6 in. wide at the periphery, these being located directly beneath the chimneys, each in line with the flue, which under ordinary working conditions it serves. The four boiler flues, however, are cross-connected, so that three fans can serve four rows of boilers, in case one of the fans has to be shut down for any reason.

When the economisers are in operation, the four fans produce the necessary draught to operate 20 of the 24 boilers at 50 per cent. above their rated capacity, with fuel giving an evaporation of 7½ lb. of water per pound of coal. The fans are driven by Chandler & Taylor automatic steam engines, the steam required to drive the fans at their normal output being materially less than 1 per cent. of the boiler horse-power they serve.

There are eight separate economisers of the Westinghouse patent circulating pattern, provided with scraping gear and manufactured by the Green Fuel Economiser Co. Each economiser is made up of 52 sections consisting of 12 tubes each.

The arrangement of economisers and flues is such that each economiser serves three boilers, and any economiser can be by-passed as desired.

In designing the flue construction, practically 40 sq. ft. of flue area was allowed per 1,000 rated boiler H.P. of the station, but as the boilers are designed to run considerably above-rating, this cuts down the flue area per nominal H.P. delivered by the boilers to approximately 30 sq. ft. per 1,000 boiler H.P.

The engine room contains four 3,000 KW. four-stage Curtis turbines, built by the General Electric Co., of Schenectady, New York. These turbines are of the vertical pattern and closely resemble, above the floor line, the generating units installed in the Cataract Construction Co.'s power house at Niagara Falls. The generators deliver three-phase alternating current at a pressure of 4,600 volts, the frequency being 60. The machines have been designed to withstand very heavy overloads, and they can be run continuously without damage at 50 per cent., and for a short time at 70 per cent. above their rated capacity. The generating units are carried on hollow circular concrete foundations arranged to give access to the step-bearings, which are one of the most novel features of the station. The entire weight of the revolving portion is carried on a film of water, the water pressure being maintained by a system of pumps and pipes leading to the step-bearings and an accumulator, which ensures an even pressure on the bearings at all times, thus keeping the rotating element in a fixed horizontal plane. Oil is used only on the steady bearings, which keep the rotating element in a vertical position, this oil being circulated and purified by a specially-designed oiling system; the oil circulation is maintained by small duplex steam pumps, which are in duplicate.

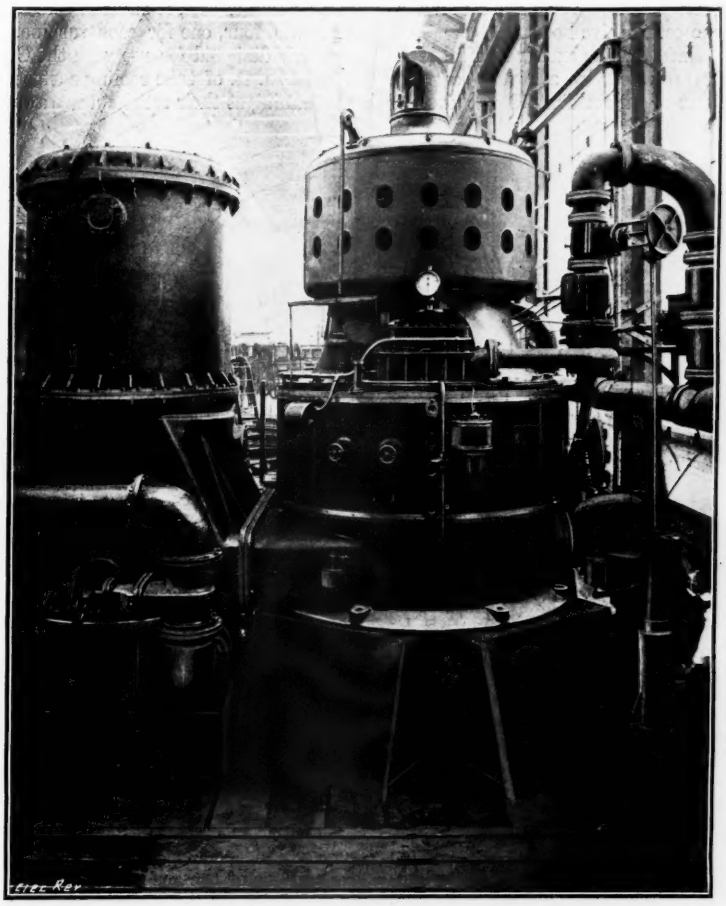


Fig. 5.—1,500-kw. Three-Phase Turbo-Generator.
(Constructed by the B.T.-H. Co. for the Yorkshire Electric Power Co.)

Fig. 6.—Stationary Armature for B.T.H. Turbo-Generator Shown Above.

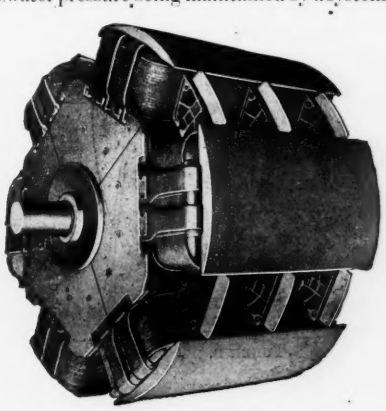


Fig. 7.—Revolving Field for Turbo-Generator Shown Above.

The excitation current for the alternators is supplied by two 50-KW. motor-generators. These are used in connection with a storage battery of 83 cells, which is kept as a reserve to maintain a uniform excitation in the event of accident to an exciter unit. The battery at 125 volts has a capacity of 400 ampere-hours for two consecutive hours.

The battery floats at all times on the exciter system, each motor-generator set being protected by a reverse current circuit-breaker, which, in case of an accident to the exciter in use, automatically disconnects it from the system and leaves the excitation of the generators entirely to the battery. The latter is charged by raising the voltage of the exciter, which can be varied from 125 to 200 volts.

The current generated by the four main units is taken direct to the bus-bars of a 24-panel high-tension switchboard, through various oil switches and instrument transformers located in the two lower switchboard compartments. The bus-bar construction of this board is divided into four sections, which can all be interconnected when desired or run independently, each section being provided with a switch for a 3,000-KW. alternator, and five switches for feeders.

Nine feeder panels are already in use, six of which control trunk feeder lines. These trunk lines are cross-connected in the town by what are known as ties, thus reducing to a minimum the possibility of a shut-down, due to the burning out of any one of the trunk feeders.

The conduits carrying the trunk lines have sufficient capacity for 18 additional trunk feeders, of which three will be installed this year, to serve three additional 1,000-KW. motor-generator sets, which are already on order.

IG. 8.—Fourth-stage Diaphragm of B.T.-H.-Curtis Turbine, showing Nozzles.

Fig. 9.—Revolving Bucket Ring.

The engine room is spanned by an overhead travelling electric crane, capable of dealing with loads up to 35 tons. The main exhaust system which serves the turbines is so arranged that when the exhaust steam is not used for the evaporation of salt, it is taken direct to condensers, of which there are four, one for each turbine. The condensers were specially designed for use with the Curtis turbines; each has 12,000 sq. ft. of tube cooling surface, and when the turbines are running at their rated output, a vacuum of 28 in. is maintained with circulating water at 70° F. Each condenser is provided with a triplex motor-driven Edwards wet vacuum pump, and an 18-in. motor-driven centrifugal circulating pump.

The whole of the water used in the station is taken from the Detroit River through screens into a pumping house, from which it is circulated to the various points in accordance with requirements.

The pumps supplying the circulating water to the condensers and those supplying water to the heaters and to some elevated tanks are located on the main floor of the pump house, each pump having an independent suction line about 14 ft. long. Each battery of six boilers is fed by an independent boiler feed pump, which receives its supply from a separate feed-water heater. The condensing systems are entirely independent, the idea being that it would be cheaper to run one of the generating sets at high pressure for a short time in the event of anything happening to its condensing equipment, rather than to have the constant expense of keeping a complicated system of cross-connecting exhaust piping, air-tight.

The circulating water, after having passed through the several condensers, discharges through an overflow pipe into a common culvert extending beneath the four condensers. The overflow pipe is carried below the water line of the canal, so as to get the benefit of the siphon effect in operating the system. The only valve or regulating device in the system is the one in the discharge pipe from the condenser, which regulates the amount of water passed through the latter. The overflow canal under ordinary working conditions is arranged to discharge into the river, but there is a bye-pass arrangement, so that in the winter the circulating water can be used over and over again, it being discharged against the screens, in order to keep them free from ice.

The water used for boiler feed and other purposes in the station, is taken from a hot well outside the pump house

Fig. 10.—Complete Wheel for Four-stage Turbine.

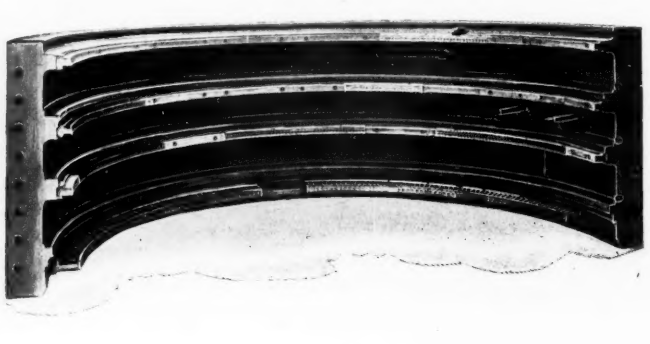


Fig. 11.—Steam Casing of Four-stage Turbine, showing Stationary Intermediates.

basement, the make-up water only being taken from the latter. Duplicate 8-in. motor-driven Worthington low-pressure turbine pumps, each capable of supplying all the water required to operate the station, force the hot-well water through cast-iron mains to four 5,000-H.P. Cochrane feed-water heaters. Connected to the two mains are two elevated tanks of 65,000 and 10,000-gallon capacity respectively, which serve the two purposes of keeping a uniform pressure on the mains and of providing an emergency supply in case of accident to the operating pump.

As a precautionary measure, each of the boilers is fitted with a 500-H.P. Penberthy injector, which receives its water supply under pressure by means of a special piping system from the elevated tanks, there being thus three separate ways of boiler feeding.

In order to minimise as much as possible the expansion and contraction of the steam mains, and radiation losses also, the pipes are made as short as possible, the expansion being allowed for by bends and cross-runs.

Superheated steam is only used for the main generating sets, the auxiliary plant being run with saturated steam at 200 lb. pressure, the boiler connections for which are so made, that it is impossible for superheated steam to reach the auxiliaries.

The steam pipes are covered with a built-up covering of plastic asbestos and magnesia cement, 3¾ in thick.

It now only remains to refer to the methods employed in the handling of coal. Briefly, the scheme consists of an elevated railway track for bringing the coal into the yard; a hoisting tower for raising the coal to the level of the top of the bunkers over the boilers, and an industrial railway for taking the coal from the tower and delivering it to the bunkers. This arrangement was selected after various coal handling schemes had been investigated, such as bucket and belt conveyors, telpherage schemes, &c. The railway trucks filled with coal are shunted into the power station siding by the railway company; they are then hauled up the incline to the coal tower, or the coal is dumped from the elevated trestle to the ground, from which position it can be taken up at any time by a locomotive crane, loaded into a gondola car, and delivered to the coal tower. The elevated coal track is fitted with a runway on both sides, so that the coal can either be dumped or shovelled out; it being finally shot into an unloading hopper under the coal tower.

Should the coal be brought in, in such a frozen condition that it cannot be moved, it can be thawed by means of a steam jet leading from the boilers.

From the unloading hopper the coal is raised by a steam-operated "Hunt" tub coal hoist, capable of dealing with 70 tons per hour, which discharges its contents into a 20-ton hopper situated 110 ft. above the level of the boiler room floor. This hopper is provided with a bar or grill bottom, which allows the fine coal for use in the stokers to fall into a lower hopper. The large lumps are subsequently broken up by heavy engine-driven coal crackers until able to pass through the grill bottom. This hopper is so designed that all or any part of its contents can be delivered either to revolving screen or to a third hopper beneath it, from which the Industrial coal trucks, which receive the screenings, are loaded. From the screen the chutes are also arranged to deliver screenings to the third hopper, and nut coal to a fourth hopper, both these hoppers delivering their contents to trucks on the industrial railway, which in turn delivers the coal to divided bunkers over the boilers. By this means the screenings and nut coal are kept entirely separate, and it is, we believe, the first central station where such an arrangement has been successfully carried out.

With two varieties of coal available, it is always possible to increase the capacity of the station from 50 to 75 per cent. above ordinary working conditions for a short time, by feeding the furnaces solely with nut coal.

By a special arrangement of trips, every other car on the Industrial Railway can be filled from the third or fourth hoppers, and will deliver its charge into the proper hopper compartment of the bunkers.

This coal-handling scheme is operated throughout by steam, with the exception of the revolving screen, which is motor-driven; the initial and operating costs coming out rather on the side of steam than of electric driving. Coal is delivered from the bunkers over the boilers, direct to the stoker hoppers by gravity, the chutes being bifurcated at the top, so that one branch goes into each of the compartments of the bunker. Each of these branches is fitted with a valve, so that the fireman can, by means of a chain, feed either class of coal to the stokers at any time.

The coal yard has a capacity for about 80,000 tons of coal, the consumption per day varying from 215 to 300 tons. When the plant is running non-condensing in connection with the salt works, about twice as much coal is needed. The coal-handling apparatus runs for 4 hours per day when running condensing, and 8 hours per day when non-condensing.

The ash-handling apparatus consists merely of concrete brick-lined hoppers situated beneath each pair of stokers, which deliver their ash automatically. From these hoppers the ash is delivered by gravity to trucks running on an industrial railway in the basement, the cars of which can be run out into the yard and dumped when convenient.

At the present time the grade is such that these cars can be pushed by hand, but as the property is brought up to the contemplated level round the power house, it will probably be necessary to provide some mechanical means for hauling the cars. In all probability an electric storage battery locomotive will be installed.

THE BRITISH THOMSON-HOUSTON CO'S. TURBINES.

Whilst figs. 5 to 11 do not actually represent the identical turbines installed in the Detroit station, we have thought it worth while to add them to the article as representing the parts of exactly the same type of machine; they are taken from the Curtis turbines manufactured by the British Thomson-Houston Co., at Rugby, and described in our issue of May 19th last. Fig. 5 is a view of a 1,500-KW. Curtis turbine on the test bed at the B.T.-H. Co.'s works, one of the machines built for the Yorkshire Electric Power Co.'s Thornhill station, with separate vertical condenser adjoining. Figs. 6 and 7 illustrate the construction of the stator and rotor of this machine, showing the special construction of the latter in order to cope with the severe stresses due to centrifugal force. Fig. 8 shows one of the diaphragms intermediate between two of the four stages, pierced with holes forming the so-called nozzles. Fig. 9 shows one of the bucket rings, consisting of a single solid ring of weldless steel, out of the edge of which the buckets are cut, and provided with steel straps round the periphery riveted on the ends of the vanes, so as to form a shrouding. Fig. 10 shows the complete rotor of a four-stage Curtis turbine. Fig. 11 represents the interior of the casing of the turbine, and shows the arrangement of the successive rings of stationary vanes, corresponding with the various stages of expansion. These rings do not consist entirely of vanes, the width of the sections of vanes depending upon the stage, and therefore the volume of steam passing through them.

TELEGRAPH AND TELEPHONE NOTES.

Australia.—Advices received by the Australian mail delivered in London on Wednesday evening, state that the Federal Postmaster-General, the Federal Minister of Defence, and the British Admiral in command of the Australian squadron, have under consideration an important and far-reaching scheme for the installation of the Shoemaker system of wireless telegraphy which has been submitted by Mr. J. W. Hamilton, attorney in the Commonwealth for the International Telegraph Construction Co., of London and New York. The scheme, so far as it affects the Commonwealth, proposes to couple up New Zealand with Australia direct, and again *via* Tasmania, and also *via* Lord Howe Island and Norfolk Island; then to link Queensland with Port Moresby in New Guinea, and with Samari in the same possession. It also embraces a series of stations beginning in Queensland and reaching out to Tapp Island in the Caroline Group, and so on to the cable routes radiating from Tapp Island *via* Samari and Herbert's Shoe in German New Guinea. So far as the Admiralty is concerned, the scheme proposes to install six of the ships of the Australian squadron with instruments at a cost which, for a few hundred pounds will, it is stated, place Admiral Fanshawe in possession of absolute control of the receiving and transmitting apparatus, without any vexatious royalties to pay or outside interference to combat. The inducement held out in connection with the linking of New Zealand and Tasmania with the

Shoemaker system is a reduction in the rates for messages from 4½d. to 1d. per word. The guarantees in the matter of a continuous service that are offered by Mr. Hamilton to the Commonwealth Government embrace a minimum continuous transmission of 25 words a minute where poles or an elevation of 200 ft. are obtainable, and a maximum of 40 words per minute.

Halifax.—From a joint report of the Chamber of Commerce and the T.C. dealing with unsatisfactory trunk services, we gather that the average time of 211 calls to Bradford was 9·67 minutes, the shortest time one minute (frequently), and the longest 38 minutes; whilst in the case of 107 calls to Huddersfield the average time was 11·5 minutes, and the shortest and longest times 1 and 35 minutes respectively. The trunk wires at present available for traffic between Halifax and certain towns are as follows:—Bradford, 10; Leeds, Manchester and Huddersfield, 4 each; Sheffield, 1; Dewsbury, 2; Liverpool, Rochdale and Todmorden, 1 each. The trunk circuits in course of construction from Halifax are 1 to Leeds, 2 to Huddersfield, and 1 to Manchester. The report concluded by stating that the N.T.C. had agreed to a scheme for bringing all subscribers within the mile tariff; the rentals to be on the basis of one mile within the borough, and extra mileage rentals to be reduced. Arrangements were authorised by the company for enabling a subscriber to ascertain the probable delay in the event of the line being engaged.

Melbourne.—The estimated cost of the proposed telephone between Melbourne and Sydney is £30,000. The Victorian section will cost £11,000, and the New South Wales Section £19,000—the line proposed being of sufficient capacity to carry extension traffic to Brisbane and Adelaide if required. The probable value of the line is still under consideration.

Natal Telegraphs.—The report of the Postmaster-General of Natal states that the receipts for telegraph business for the financial year ended June 30th, 1904, amounted to a total of £69,474, a decrease on the previous year of £19,521. Of this revenue, £10,984 represented the value of work done for Government departments, and £866 the 50 per cent. reduction on telegrams transmitted on behalf of the military authorities. The total number of messages dealt with was 2,266,697, a decrease of 89,581 on the previous year. The most important works carried out were new lines from Pietermaritzburg to Mooi River, Natal-Cape Railway Line, Pietermaritzburg to Dundee, Dundee to Newcastle, Charlestown to Natal-Transvaal border, the latter three lines providing improved facilities with the Transvaal. The construction of the main lines throughout the Colony puts the telegraph system in a most excellent condition.

In connection with the Durban telephone construction, 2,050 ft. of 3-in. cast-iron pipe has been laid, and 3,350 ft. of cable has been drawn in during the month of May; seven new telephone connections were made during the month, making a total of 1,000 subscribers.

New Marconi Services.—The Marconi installation at Sable Island and Halifax (Camperdown station) installed under contract with the Canadian Government, has been completed, and these two stations are now in full operation. Marconi wireless stations at Whittle Rocks and Cape Rich are in course of erection, and it is expected that by July 31st a complete inter-station service will be provided between the following stations on the Canadian and Newfoundland coasts:—Fame Point, Heath Point, Cape Ray, Whittle Rocks, Cape Rich, Point Amour, Belleisle, Cape Race, Halifax, and Sable Island. This service has been established by the Canadian Government primarily as an aid to navigation in Canadian waters, and as a substitute for the landline service along the shores of the St. Lawrence, which is subject to frequent breakdowns owing to bad weather.

Newfoundland.—The *Morning Chronicle* of Halifax, Nova Scotia, in dealing with Newfoundland's new Budget, summarises some of the new proposals for raising Revenue. These would not appear favourable to telegraph interests, for companies doing telegraphic business are called upon to contribute $4,000 a year for each live cable landed in Newfoundland; $4,000 a year for each wireless telegraphic station; 1 per cent of the total earnings from messages passing either over landlines or by wireless means within the Colony, and $4 for each telephone.

The Commercial Cable Co. has agreed to lay, for the Newfoundland Government, by September next, some 200 miles of submarine cable between Port-au-Basques, Newfoundland and Canso, Nova Scotia, to connect with the Cable Co.'s landlines. The Canadian Government has granted permission for the cable to land in its territory.

Pacific Cable Conference.—Further meetings of the Conference have been held at the Colonial Office, Mr. Lyttelton presiding.

Russian Telegraphs.—The *Journal Télégraphique* in its last issue reviews the official report on the Russian telegraphs and telephones in 1902. During this year there were 152,229 kilometres of line, and 351,853 of wire, being an increase of 2,506 and 9,895 kilometres of line and wire respectively over the previous year. Altogether, 2,333 faults in connection with the poles, and 18,309 with the wire were attended to, and 114 new offices were opened during the period under review, bringing the total number of offices up to 3,024. The railway systems own 66,860 kilometres of line with 178,745 of wire, and 3,458 offices. The military and police systems comprise 498 kilometres of line, of which 316 are aerial and 182 subterranean. During the year 20,113,291 telegrams were dealt with, being an increase of 409,964. 85·4 per cent. of this traffic was private inland, and 14·6 per cent. private international telegrams, and the number of all telegrams averages 142 per 1,000 inhabitants. There were 2,471,320 European telegrams, of which 1,013,659 were sent to and received from Germany; 377,183 to and from Great Britain; 307,357 to and from France; and 200,278 to and from Austria and Hungary, Belgium being the next highest with 93,907 telegrams. Telegrams to extra-European countries were not numerous, as the following figures will show:—To and from China, 15,472; Persia, 24,157; America, 15,227; Japan, 8,263; Egypt, 6,604.

Telegraph Convention.—The adhesion of the Deutsch-Niederlandische Telegraphen-Gesellschaft to the Telegraph Convention of St. Petersburg has been officially announced.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1)	Aug. 26, 1901	
Trinidad-Demerara (No. 2)	July 1, 1905	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
Paramaribo-Cayenne	May 25, 1905	
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	
Tarifa-Tangier	Jan. 18, 1904	
Closed { Vladivostock-Nagasaki	Feb. 9, 1904	
Closed { Port Arthur-Chifu	Mar. 9, 1904	
Jamaica-Colon	Jan. 5, 1905	
Bolama-Bissao	June 21, 1905	
St. Jacques-Haiphong	June 26, 1905	
Landlines.		
Puerto-Barrios	July 28, 1902	
Kertch-Soutehoum	Sept. 27, 1904	

CONTRACTS OPEN AND CLOSED.

OPEN.

Austria.—The River Danube Regulation authorities in Vienna are inviting tenders until the 29th inst. for the establishment of an electric lighting and power station at the Port of Freudenaer.

Bath.—July 17th. Supply and erection of a storage battery. See "Official Notices" to-day.

Burton-upon-Trent.—July 7th. Overhead equipment of 1¾ miles of tramways. See "Official Notices" June 23rd.

Caerphilly.—July 24th. Cables, kiosks, transformers, switchgear, lamp pillars for the U.D.C. See "Official Notices" June 30th.

Dublin.—July 21st. Machinery oils for the Corporation. See "Official Notices" to-day.

Dublin.—July 25th. Tenders to the Corporation for three electric locomotives, tramways, mains, trolley wires, capstans, &c. See "Official Notices" to-day.

Erdington.—Construction of Section 1 of the U.D.C. tramways, about 2½ miles double track. Names and addresses of those wishing to tender should be sent to Mr. R. Green, 37, Waterloo Street, Birmingham, and Mr. H. H. Humphries, Public Hall, Erdington.

Fulham.—July 12th. Extension of mains, &c. See "Official Notices" June 23rd.

Hamilton.—July 15th. The Corporation invites offers for the construction and working of electric tramways. See "Official Notices" June 23rd.

Ilford.—July 11th. Cable for the U.D.C. See "Official Notices" June 30th.

Islington.—July 12th. (*a*) 1,500-KW. steam turbine, alternator, exciter, condensing plant, &c.; (*b*) cooling tower; (*c*) steam, water and circulating pipes. See "Official Notices" to-day.

L.C.C.—July 11th. Two low-tension feeder switchboards for L.C.C. tramways sub-stations. See "Official Notices" June 23rd.

L.C.C.—July 11th. Four sets of switchgear for tramway sub-stations at Battersea, Clapham, Streatham and Wandsworth. See "Official Notices" June 23rd.

Loughborough.—July 18th. Stores, &c., for the electricity department. See "Official Notices" June 30th.

Melbourne.—July 14th. Arc lamps, poles, brackets, &c., for street lighting for the Council. See "Official Notices" May 12th.

Neath.—July 17th. Mains, sub-stations, switchboards, feeder and switch pillars, excavations, &c., for the U.D.C. electric lighting scheme. See "Official Notices" June 30th.

Newport (Mon.).—July 8th. Piping, cooling tower, and condenser, for the Electricity Committee. See "Official Notices" June 23rd.

Rotherham.—July 8th. Tramway department stores and materials for one year. See "Official Notices" June 30th.

Salford.—July 10th. Fuel for the electricity works for one year. See "Official Notices" June 30th.

Shoreditch.—July 18th. Two 1,500-KW. steam turbo-generators, condensers, pumps, piping, &c. See "Official Notices" June 23rd.

Spain.—Tenders have just been invited by the municipal authorities of La Rambla (province of Cordoba) for the electric lighting of the town during a period of 20 years.

War Office.—September 1st. Tenders invited for the purchase of surplus boilers, dynamos, &c., at Bermuda, Barbados, St. Helena and Woolwich. See "Official Notices" to-day.

Weymouth and Melcombe Regis.—July 14th. Stores and coal for the electricity department. See two "Official Notices" June 23rd.

Wishaw.—July 11th. Mains, roadwork, and street arc lamps. See "Official Notices" June 30th.

CLOSED.

Aston.—The tender of the Brush Electrical Engineering Co. for the overhead equipment of the tramways in High Street, Birchfield Road, Lozells Road, Witton Road, and Wheeler Street, has been accepted, at £4,506.

Barnstaple.—The T.C. has accepted the tender of the Tudor Accumulator Co. for the maintenance of batteries at the electricity works for five years, at £120 per annum.

Bolton.—The Maco Spinning Co., Ltd., has accepted the tender of Messrs. W. P. Theermann & Co., of Manchester, for 1,050 lights, with all fittings, also dynamo and main switchboard.

Buxton.—The U.D.C. has accepted the tender of Messrs. Veritys, Ltd., for the supply of their single enclosure "Aston" arc lamps for street lighting.

Bristol.—The electric lift installation at the tobacco warehouse of the Corporation has been ordered from Messrs. Holt and Willetts, of Cradley Heath.

Cable Contracts.—Messrs. Johnson & Phillips have obtained contracts for the supply of cables from the Corporations of Ipswich, Grimsby and Handsworth, the Great Northern Railway Co., and the Admiralty (for Pembroke Dockyard).

Cradley Heath.—The electric power and lighting plant for Lloyd's Proving House Co., Ltd., comprising a Belliss engine and dynamo, electric and portable crane, &c., is to be carried out by Messrs. Holt & Willetts, also of Cradley Heath.

France.—The French Post and Telegraph authorities in Paris have just placed an order with La Société Industrielle des Telephones, Paris, for 80 kilometres of telephone cable (7 pairs of conductors), at 1,699 fr. per kilometre.

Glasgow.—The contracts for the generating plant and for the boilers and superheaters required for the electrical installation at Clydebank Dock, belonging to the Clyde Navigation Trustees, have been placed with Messrs. Siemens Bros. & Co., Ltd., London, and Messrs. Babcock & Wilcox.

The tender of Messrs. W. C. Martin & Co. for the electric lighting of the outer basin of the Dock has been accepted by the Trustees, as also the offer of the General Electric Co., Ltd., to supply electrical stores for one year.

The Tramways Committee has recommended for acceptance the offer by Messrs. Crompton & Co. to supply batteries, generators, &c., and operating switchgear.

London.—The Fire Brigade Committee of the L.C.C. has accepted the following tenders for the wiring of new fire stations by Mr. A. H. Marshall:—South Battersea Station, £155 10s.; Westminster Station, £196 10s.

Luton.—The T.C. has accepted the following tenders:—Section A, boiler house plant, Messrs. Tinkers Ltd., Hyde, £756; Section B, one steam dynamo, Messrs. W. H. Allen, Son & Co., Queen's Engineering Works, Bedford, £1,713 10s.; Section C, steam, exhaust, feed and blow-off services, drain pipes, floor plates, &c., Messrs. Babcock & Wilcox, London, £280; total, £2,749 10s.

Marylebone.—The B.C. has accepted the following tenders for annual supplies of stores for the generating station:—Geo. Hatch, Ltd., white cotton waste, £1 13s. 6d. per cwt., common ditto, 18s. 6d. per cwt.; W. H. Wilcox & Co., Ltd., mutton cloths, £1 18s. per cwt., sponge cloths, 18s. per cwt., lubricant, for grease lubricators, 3d. per lb., asbestos packing, 1s. 2d. per lb., rubber insertion, 1s. 6d. per lb.

Shoreditch.—The B.C. has accepted the tender of the Sloan Electrical Co. for the annual supply of arc lamp carbons, at prices ranging from 15s. 9d. per 1,000 for 9 in. by 13 mm. to 33s. 5d. per 1,000 for 10 in. by 18 mm.

Stoke-on-Trent.—Messrs. Couldon's Ltd., have accepted the tender for 850 lights, with all fittings, main switchboard, six motors, dynamo, steam engine and boiler, of Messrs. W. P. Theermann & Co., Manchester.

FORTHCOMING EVENTS.

Saturday, July 15th.—At 7.30 p.m. Birmingham and District Electric Club. Mr. W. S. Yarrow on "High Tension Switchgear and Apparatus."

Wednesday, July 19th.—North of England Institute of Mining and Mechanical Engineers. Excursion to inspect the Barton and Forcett Mountain Limestone Quarries. Assemble at Darlington Railway Station at 1 p.m.

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

THE following orders are issued for next week:—

Thursday, July 13th.—Recruits and non-efficients for Felixstowe Camp, parade at Liverpool Street Station (G.E.R.) at 11.15 a.m.

Saturday, July 15th.—Efficients for Felixstowe Camp, parade at Liverpool Street Station (G.E.R.) at 11.15 a.m.

J. GUNN, Sgt.-Major.
For O.C.E.E.R.E. (V.).

NOTES.

Conversazione of the I.E.E.—On Thursday last the annual conversazione of the Institution of Electrical Engineers took place at the Natural History Museum, South Kensington; the guests, numbering more than 1,400, were received by the President and Mrs. Siemens, the President-Elect, Mr. J. Gavey, and Mrs. Gavey, and members of the Council.

The string band of the Royal Engineers, under Mr. Neville Flux, performed an excellent programme of music in the Central Hall, and the Leoni Ladies Quintette played in the Reptile Gallery; the arrangements were, as usual, excellent, and the function was in every way a success, in spite of the fact that it fell on the same evening as the conversazione at King's College and during the convention of the Municipal Electrical Association in Edinburgh. Surely it would be possible to avoid the clashing of these events.

His Excellency the *Diplodocus Carnegii* held a well-attended reception during the evening in the Reptile Gallery, with stoical endurance—without turning a hair, in spite of the warmth of the evening. In fact, his cool appearance presented the ideal of comfort and ease. It was doubtless the fact that he was only "paste," and not the real insect, that permitted irreverent visitors to address him as "diplochocolates."

Many distinguished guests were present during the evening; amongst these were the Hon. Sir W. Arbuckle, Col. G. F. O. Boughey, the Hon. Sir H. B. Buckley, Sir C. P. Clarke, Sir W. Crookes, Mr. R. K. Gray, the Hon. W. C. Gully, Capt. H. B. Jackson, Sir J. N. Lockyer, Sir H. C. Mance, Lord Strathcona and Mount Royal, Sir J. W. Swan, Mr. Jas. Swinburne, Prof. S. P. Thompson, and other well-known visitors and members of the Electrical and other Institutions.

Institution Notes and Lectures.—The members of the Civil and Mechanical Engineers' Society on Thursday last week paid a visit to the generating station of the London Underground Electric Railways Co. at Chelsea, and were shown over the buildings.

THE ACADEMIC SIDE OF TECHNICAL TRAINING.—On the very eve of the public announcement that the well-deserved honour of a knighthood had been conferred upon him, Prof. A. B. W. Kennedy, F.R.S., &c., delivered on June 29th last before the Union Society of University College, London, the foundation oration bearing the above title. Sir Alexander, as we may now call him, began his lecture by briefly sketching the rise and progress of systematic engineering education in this country, referring to the paper which he had himself read in the same theatre on the same subject 30 years ago, and devoting a few words of kindly recollection to the early days when, he said, both professor and students at Gower

Street had much to learn, doing good work, although they were only allowed £500 a year to spend on the laboratory. The orator next proceeded to review the present position of affairs, and to outline his aspirations for the future. When dealing with the present, two points in Prof. Kennedy's address were very conspicuous: his almost unrestrained admiration for the methods adopted by our medical men for the training of their students and successors, and his sturdy belief in the excellence of the engineering education now given at most British Institutions, University College not excepted.

Dr. Kennedy holds that the academic training of engineers should be so arranged as best to train the best engineers, by which he means that the complete engineer is neither a man who knows nothing but engineering, nor a "by-product" of the training. There is a tendency among mathematicians to exalt the processes by which a certain result is obtained at the expense of the result itself; in daily life, and in practical engineering, it matters less if the methods are admirable, so long as the result is correct. In order to be sure that his result is trustworthy, a man must have some knowledge of the subjects lying alongside his own; and therefore a student in applied science cannot be said to understand his own branch up to the point at which his studies have stopped. Nevertheless, in those departments of science that the student is not afterwards to make his own, he may with advantage be taught to some extent dogmatically, for statements made in general terms are better and more intelligible than when they are safeguarded with the qualifications which perfect accuracy demands. In examinations (and elsewhere) answers cannot be more precise than the questions propounded, and it would perhaps benefit all if examiners would seek the aid of consulting engineers in assuming data that are not ideal.

Prof. Kennedy brought his address to a conclusion by advocating, in somewhat guarded terms it seemed to us, the plan whereby professors and consultants occasionally or periodically exchange posts, and the former are encouraged to practise. The argument usually employed for this system is that it prevents the crystallisation of the professor, but Dr. Kennedy puts the matter in another shape. Unless the consultant re-appears at the lecture table a few years after he has left college, and soon after he has become successful in the world, his efficiency as a teacher begins to diminish, for he forgets how to impart knowledge and loses touch with students and their ways of thought. This is a neat retort, for no doubt from an academic point of view at least the consultant is as prone to solidify as the professor. A pessimist may conceivably urge that the practising professor and the teaching consultant both resemble the Church at Laodicea in being neither cold nor hot; but optimists, like Dr. Kennedy and our American friends who have thoroughly investigated the question, may reply that they also resemble the crystalline fluid or fluid crystal which, though lukewarm, is ready under comparatively slight changes in external conditions to assume either state of matter in full perfection. Prof. Kennedy pointed out that besides this direct association of industry with science, there should be a closer relationship between the practising graduate and the college whence he has come—a relationship which we fear is not always cultivated by the institution—so that good contact may be always maintained not merely between student and adept, but equally between adept and student. Sir Alexander Kennedy thus gave us an address containing much matter for fresh thought and even satisfaction, although in many passages it was unintentionally reminiscent of the report drawn up by the Mosely Educational Commissioners.

In seconding the vote of thanks to the orator, which had been moved by a student, Lord Reay, the President of the College, made a short but interesting speech. After expressing his natural pleasure at hearing that Prof. Kennedy was satisfied with the present phenomena of engineering education, Lord Reay went on to say that the authorities of University College were fully prepared to give every possible assistance to any scheme which the Departmental Committee appointed by the Board of Education, and now in existence, might formulate. As a member of that Committee, he was unable to speak definitely on the subject, but he could assure his audience that London students of engineering would eventually be as well off for educational facilities as any students in the United States.

At the close of the proceedings a pleasing episode occurred. The students of the Engineering School at University College took the opportunity of presenting an inscribed silver bowl and stand to Prof. L. F. Vernon-Harcourt, M.I.C.E., on the occasion of his retirement from the Chair of Civil Engineering, a post which he has occupied since 1882. The presentation was made in suitable terms, and on rising to return thanks, Prof. Vernon-Harcourt was received in a most enthusiastic manner by the company of 150 or 200 persons, among whom there were many coloured hoods, some borne by ladies.

Society of Arts.—On Tuesday evening the annual conversazione was held in the gardens of the Royal Botanic Society, Regent's Park; Sir William Abney, K.C.B., the chairman, and other members of the Council, received the guests, who attended in great numbers. The Tropical House and Conservatory were open, and there was an exhibition of roses and other flowers by Messrs. Paul & Sons, of Waltham Cross, in a marquee, while the grounds were beautifully decorated with myriads of lamps. The string band of the Royal Artillery and the band of the Grenadier Guards provided a musical entertainment, and in addition there was an excellent concert in the Club House; Mr. Patrick Kirwan's Idyllic Players gave two selections from pastoral plays ("Midsummer Night's Dream," and "The Tempest"), in the gardens, which were highly appreciated, though, unfortunately, Mr. Kirwan was attacked by a sudden illness, which prevented him from taking part in the second performance. The weather was favourable, and all the conditions contributed to render the occasion in every way successful.

Institution of Mechanical Engineers.—The summer meeting of the Institution was held this year at Liège, where the members were received by the Bourgmestre, Mr. Kleyer, and aldermen, on June 19th. A reception committee of the Liège Association of Engineers made arrangements for the entertainment of the visitors. There were several excellent papers read during the meeting. The most interesting from the electrical engineer's point of view were one by Prof. Paul Habets, of Brussels, on "Electric Winding Machines," in which the problem of electric winding was treated mathematically, with illustrations from practice; one by R. E. Mathot, of Brussels, on the growth of large gas engines on the Continent, forming a very complete summary, with numerous excellent illustrations, of the subject named, and the present stage at which the construction of gas engines has arrived; and "An Investigation to Determine the Effects of Steam-Jacketing upon the Efficiency of a Horizontal Compound Steam Engine," by A. L. Mellanby, of Manchester. A paper on "Ferro-Concrete Construction," by E. Noaillon, of Chênée, also is of indirect interest to electrical men. We shall deal with these papers in later issues.

Royal Institution.—At a general monthly meeting of the members on the 3rd inst., Sir James Crichton-Browne in the chair, the special thanks of the members were returned to Sir Andrew Noble for his donation of £100 to the Fund for the Promotion of Experimental Research at Low Temperatures; and to Mr. Rollo Appleyard for his gift of a portrait of the late Prof. J. D. Everett, F.R.S., M.R.I.

Industrial Freedom League.—The third annual meeting was held at the Westminster Palace Hotel on Friday last; Lord Avebury presided, and in moving the adoption of the report, made a powerful protest against "the portentous and rapid increase of municipal expenditure," which had aroused the anxiety of all thoughtful citizens. Lord Brassey was elected president of the League.

The Prodigal's Return.—An entertaining young contemporary, who has always looked upon us with a measure of filial regard, some little time ago, in spite of our protests, took a journey into the far country of fiscal myth. We are very pleased to learn that he is coming to himself, and that we may shortly have the pleasure of welcoming him back home. In the last issue of our contemporary we read: "Broadly speaking, the claims of the power-user ought to take precedence in questions of this kind, even over the claims of the existing companies to the protection of their capital." This remark is in connection with the Electrical Power Bills now before Parliament. The same sentiment applied to the general question of international trading, viz., the claims of the consumer before those of the manufacturer, precisely expresses those views upon which we have sometimes been taken to task by our youthful contemporary. We are fattening up the calf, and have given the order for the wedding robe and ring, and are now on the look out for a suitable bride. One with plenty of money would be preferred, who would look upon the partnership in the light of an "electrical investment."

British Fire Prevention New Testing Station.—Sir William Preece, K.C.B., F.R.S., as senior member of the Council of the British Fire Prevention Committee, on June 28th, started the first test at the Committee's new testing station near Regent's Park, when various systems of floor construction, doors, and fire-resisting glazing were under investigation. There was a large attendance of public officials during the afternoon, including several representatives of foreign authorities. In his opening address, Sir William Preece specially remarked upon the necessity of the municipal authorities aiding the voluntary efforts of the Committee in the investigation of fire preventive questions.

Tramway Deputation to the B. of T.—Sir Herbert Jekyll, on behalf of the Board of Trade, has arranged to receive representatives of the Tramways and Light Railways Association and of the Municipal Tramways Association for the discussion of certain questions in regard to tramways, viz.:—(1) The incidence of cost of guarding new post office wires crossing existing tramway lines; (2) the memorandum on details of construction and equipment issued by the Board in January, 1905; (3) the proposed monthly inspection of each separate insulator on the overhead equipment.

Canal Traffic.—At the quarterly meeting of the Birmingham Chamber of Commerce last week, a discussion took place on the development of the inland waterways of this country. Sir J. Brunner pointed out that the rates for the carriage of goods in the United Kingdom were the highest in the world. All the Chambers of Commerce and Agriculture were agreed that efforts should be made to develop the canal system, which would benefit all classes. According to the provisions of the Canals Bill, the canals would be bought with stock guaranteed by the State. A resolution was passed to the effect that the canals should be transferred to and worked by a central trust with statutory powers.

London Power Bills.—The keenest interest is manifested in the fight over the Administrative County of London and District Electric Power Bill, which was to come before the House of Commons for second reading yesterday, and a strenuous campaign has been conducted in the daily Press on both sides. The proceedings will be reported in our next issue.

On Wednesday the Central Electric Supply Bill and the County of London Electric Supply Co. Bill, which have passed the Lords, were read a second time.

London Traffic.—The report of the Royal Commission on the Traffic of London was presented to Parliament on Wednesday in dummy. The chief recommendations of the Commissioners are:—

Better locomotion to facilitate the settlement of the housing question.

A great extension of tramways linking up the entire system of the metropolis.

Free passage for tramcars over the Thames bridges and along the Embankment.

A tribunal or board to be created. This board not to be executive, but selective, and to consider all the schemes which may be submitted for adoption under the report of the Commission.

In all 400 miles of trams are advised.

The Metropolitan Underground Railways and the tube systems are not interfered with.—*Standard.*

Appointments Vacant.—Canvasser for Ilford U.D.C. (£2 per week and commission); the Bombay Electric Supply and Traction Co. requires a chief engineer for Bombay; electrical engineer for West Bromwich, at £300 per annum. See our "Official Notices" to-day.

Fatality.—A man named John Rooney was killed by an electric shock in the Imperial Tube Works, Airdrie, on Tuesday last week. He was found by a fellow-workman lying across the iron railing which guards the electric switch of the scarfing and plugging machine. On the current being cut off, Rooney was discovered to be unconscious, and in spite of artificial respiration, he died from the shock.

British Motor-Boat Club.—The Lords Commissioners of the Admiralty have been pleased to issue a Warrant, authorising members of the British Motor-Boat Club to fly the Blue Ensign of His Majesty's Fleet. The privilege is a much coveted one, and this is the first occasion on record on which such a permission has been granted for vessels of so small a size.

Various concessions are granted by Port Authorities to boats allowed to fly the Blue Ensign; these include the use of the naval part of harbours, and in foreign ports this is of particular value. The Lords of the Admiralty are watching with interest the development of the motor-boat, and though they do not see their way at present to using them for naval purposes, there is no doubt that the granting of this Warrant is due to the particular interest they take in the movement, and the part motor-boats may play should war unfortunately break out.

The Warrant authorises the Blue Ensign, without any device in the fly, to be worn; this is an extra privilege which has been granted to but few of the most important yacht clubs.

The club has an excellent programme of races for the season, including the "Entente Cordiale" Challenge Cup for 40 footers, to be raced for on August 7th. The membership is rapidly increasing, and the headquarters are now at the Craven Hotel, Craven Street, Strand, London, W.C.

Junior Institution of Engineers.—Not the least pleasant excursion last week was that of Thursday, the 29th, comprising a journey for four hours on the P.S. *Clacton Belle* to Chatham, a two hours' inspection of Chatham Dockyard, and the return trip to town by the steamer. It was, perhaps, unfortunate that with the President, Mr. Lindley, on board, all the chimneys on the Thames should have selected June 29th as a sort of fête-day on which to display their worst powers of smoking, for never did we see the lower Thames more smoky. The passage up the Medway was of interest, for there were many naval vessels to be seen. In the electrical department were noted the magnetic clutches on the shafting, by which machines were put in motion without shifting belts, and the visitors were also shown the method of hardening the new steel tools electrically by connecting the tool in a clamp to a negative wire and dipping it in a potash solution on the positive pole, so that an arc was formed at the tool point, which, when it acquired the correct temperature, was simultaneously quenched as the current was cut off. They saw also the mechanism for correctly laying gun-sights. Luncheon was served on board on the trip down, and tea on the return trip. There came also on board uninvited two streams of air, each several hundred feet long, which had just passed over two soap works. The President had to return to town by train from Chatham, in order to catch the Continental boat that evening. Altogether, the Chatham excursion was very enjoyable, especially to those to whom a visit to the dockyard was a fresh experience.

National Physical Laboratory.—A meeting was held at the House of Commons on Tuesday, on the subject of an additional State grant to the National Physical Laboratory at Teddington. The chair was taken by Mr. R. B. Haldane, K.C., M.P., and Dr. Glazebrook, the head of the laboratory, made a statement as to its aims and wants. The Government grant to the Laboratory has been raised to £5,500 for this year, and is to be £6,000 next. The Committee entrusted recently with the duty of drawing up a scheme of work placed the additional annual requirements in the course of a few years at £10,000. The staff needs increasing; the salaries are low compared with those in Government institutions of a similar character, and there are no funds for the supply of apparatus.

OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.*]

Central Station Engineers.—On Saturday, June 24th, the staff and employés of the Ealing Electricity Works held their second annual outing at Burford Bridge, Box Hill, Surrey. A party of 37 travelled by brake through Kingston, Hook and Leatherhead. On arrival at the Burford Bridge Hotel the party was photographed, and a long programme of sports was successfully carried out. Mr. J. D. Knight acted as starter, Mr. Pullen as timekeeper, and Mr. Foster as judge in all the races. Dinner was served at the Burford Bridge Hotel, and was presided over by Mr. J. DOUGLAS KNIGHT, borough electrical engineer, by whom, and Mrs. Knight, the whole cost of the dinner was borne. The long list of toasts had to be omitted in order to get through the remainder of the sports. A hearty vote of thanks was given to the chairman and his wife, and Mr. Knight responded. A cricket match and tea followed. Great credit is due to the outing committee, consisting of Mr. J. D. Knight, chairman; Mr. G. Watts, hon. secretary and treasurer; and Messrs. Pullen, Payne, Schubert and Clements.

On Sunday morning, 25th ult., Mr. W. E. J. HEENAN, the borough electrical engineer and general manager of Southend, was presented with a silver cigarrette box, silver cigarette case and silver matchbox by the members of his staff on the occasion of his leaving to take up the appointment of borough electrical engineer to the Metropolitan Borough of Bermondsey. Mr. Heenan was also the recipient of a silver clock, presented to him by the borough officials on 26th ult., when a smoking concert was held, the town clerk, Mr. W. H. Snow, presiding.

Mr. G. K. NOWLAN has resigned his position with the British Insulated and Helsby Cables, Ltd., to join the staff of the Newcastle-upon-Tyne Electric Supply Co., Ltd.

The Ladysmith T.C., on the recommendation of its E.L. Committee, has resolved not to increase the salary of the electrical engineer.

Mr. G. ANDERSON, of the Dundee Corporation electricity works, has been presented by the staff with a handsome set of carvers and silver-mounted vases as a token of esteem on the occasion of his marriage.

Mr. HAMILTON KILGOUR has resigned the post of borough electrical engineer at Cheltenham, which he has held for 10 years.

Mr. J. H. WRAY, electrical engineer to the West Bromwich Corporation, has resigned his appointment.

Mr. ERNEST T. WILLIAMS, borough electrical engineer, Gibraltar, and formerly of Belfast and Salford, was married, on July 5th, to Miss M. C. Catleugh, only daughter of R. Catleugh, Esq., of King's Lynn. The first part of the honeymoon will be spent in Derbyshire, after which Mr. and Mrs. Williams will leave for Gibraltar *via* Switzerland and Italy.

Tramway Officials.—On 27th ult. the employés of the Paisley District Tramways Co. assembled at the Elderslie depôt to take farewell of their traffic superintendent, Mr. HARRY W. LAING, on the occasion of his leaving to take up the management of the Cambridge Motor-Omnibus Co. Mr. Fred Coutts, general manager, presided. Inspector Byrne, in an appropriate speech, presented Mr. Laing with a rosewood clock, Japanese vases, and a case of pipes, together with a gold bangle for Mrs. Laing. After Mr. Laing had responded, an impromptu concert was held.

General.—On Friday last, prior to the departure of Mr. R. SHEPHERD (superintendent of the Western Province of the National Telephone Co., Ltd.) for Liverpool, to take up his new duties as superintendent of the North-Western Province, the opportunity was taken of presenting him with a silver tea and coffee service, subscribed for by the staff of the province as a slight recognition of the esteem in which he was held by them, and as a memento of over nine years spent in the neighbourhood during which it had been their privilege to be associated with him. The presentation was made by Mr. A. PERKINS (manager for Bristol district) with a cordial speech. Mr. B. WAITE (manager for Cardiff district) ably followed Mr. Perkins, and Mr. P. F. CURRALL (manager for Plymouth district) expressed his deep regret in parting with Mr. Shepherd, who had been with them for so many years. Mr. Shepherd, in returning thanks, stated that he should look back with very tender memories on the time he had spent as superintendent of the Western Province. Since he came into the Province in 1896, very considerable development had taken place, there being four times as many members of the staff, and five times as many telephones, and there was every evidence of still greater increase in the future. Mr. W. E. GAUNTLETT (Gloucester district manager), Mr. H. S. DISTIN (Swansea district manager), Mr. A. B. GILBERT (Exeter district manager) were also present, representing their respective staffs, besides a large number of the local clerical, engineering, electrical and operating staffs.

Mr. W. H. ALCOCK, late with the Pietermaritzburg Corporation Electrical Department and Messrs. Collens, Ressler & Co., engineers, Maritzburg, has been appointed electrical engineer to Messrs. Jenkins & Co., Cape Town. Messrs. Jenkins & Co. have the Cape Colony and Natal agency for the Allgemeine Electricitäts Gesellschaft, Berlin. We understand that Mr. Alcock takes control of Messrs. Jenkins's electrical and engineering department.

Mr. FRANCIS C. POLDEN, electrical engineer to the Rhodesia

Railways, Bulawayo, has returned home for a few months' holiday. His address is c/o Messrs. J. Stone & Co., Deptford, S.E.

On June 6th, at Pernambuco, Mr. F. W. A. KNIGHT, electrician c.s. *Norseman*, the Western Telegraph Co., was married to Mary Gerard Rawlinson, only daughter of the late James Rawlinson, C.E.

Mr. HENRY CLIFFORD, of Blackheath, formerly engineer-in-chief of the Telegraph Construction and Maintenance Co.'s Works, who died last May, left estate valued at £89,210 gross, with net personalty £87,718 2s. 9d.

In view of the extension of his consulting practice, Mr. MORGAN WILLIAMS has taken into partnership Mr. HAROLD W. COUZENS, M.I.E.E., and the business of the firm will henceforward be carried on under the title of Morgan Williams & Couzens. Mr. Couzens, in addition to his extensive experience of electricity supply working, has for several years past been engaged in the design and supervision of electric power, traction and lighting undertakings on behalf of Messrs. Kincaid, Waller, Manville & Dawson, so that he will be in a position to devote himself more particularly to these matters.

Mr. A. E. SHORT was again appointed on Friday last to the position of electrical instructor, under the Middlesex Education Electricity Class, Enfield Centre.

Mr. L. E. WILSON, chief electrician for the National Telephone Co. in the Manchester district, was last week presented with a Sheraton bureau bookcase by the staff, as a token of esteem on his retirement from the company's service to take up an important position with the General Electric Co. Mr. Wilson has been associated with the development of telephones since 1885, and has carried out some notable work. In July, 1898, when the King (then Prince of Wales) was confined to his room with an injured knee, he installed the electrophone there, and remained in personal attendance to ensure the supply to the royal patient of music, &c., from theatres and the opera, and of Church services. In May, 1899, he was in personal attendance on Queen Victoria at Windsor Castle for a similar purpose. The great fire at the London Wall exchange in 1902 brought Mr. Wilson's organising capacities to the fore. The fire was still burning when reconstruction was begun, and over 3,000 subscribers' lines were replaced within a short time by a large staff working day and night. No sooner had this exchange risen, as it were, from its ashes, than Mr. Wilson was sent to the important centre at Manchester, where, by much uphill work, he has re-organised the system, to the benefit of the company and the satisfaction of subscribers. That in so doing he has gained the confidence and affection of the staff, was evident at the farewell meeting when the presentation was made.

BIRTHDAY HONOURS.—It is with great pleasure that we record the fact that a few crumbs of distinction have fallen to the scientific and engineering world in the recent distribution. Lord RAYLEIGH, O.M., F.R.S., has been sworn of his Majesty's Privy Council, of which he will be one of the most distinguished members. The honour of knighthood has been conferred upon Prof. Sir A. B. W. KENNEDY, LL.D., F.R.S., of whom it must be said that the honour was richly deserved many times over, and should have been conferred long ago; Sir J. C. LAMB, C.B., late assistant secretary to the Post Office, and most highly esteemed by all classes; and Sir J. CLIFTON ROBINSON, whose activities in tramway development are well known. We tender our congratulations to the worthy recipients of these honours, and regret that the list is not longer.

Obituary.—The *Journal Télégraphique* announces the death of Mr. Gascard, secretary to the Bureau Internationale des Administrations Télégraphiques, which took place on the 19th ult., at Berne. The compilation of the official vocabulary was undertaken by this gentleman when the work was entrusted to the Bureau at the International Telegraph Conferences at Paris and Buda-Pesth.

NEW COMPANIES REGISTERED.

Bombay Electric Supply and Tramways Co., Ltd. (85,055).—This company was registered on June 27th, with a capital of £1,200,000 in £10 shares (60,000 preference), to adopt an agreement with the British Electric Traction Co., Ltd., providing (1) for the transfer to this company of the existing tramways in Bombay and of the freehold and leasehold property of the Bombay Tramways Co., Ltd.; (2) for the grant to this company of the concessions referred to in an agreement dated March 11th, 1901, between the Corporation of Bombay of the first part, W. L. Harvey, the Commissioner for Bombay of the second part, and W. G. Bingham of the third part, with certain modifications; (3) for the transfer of a licence for the supply of electrical energy, and the grant to this company of a licence for the supply of energy for electric traction in the city of Bombay; and (4) for the transfer of certain plant and materials already supplied, and the carrying out of certain works therein mentioned, to take over the said tramways and the undertaking of the Bombay Tramways Co., Ltd., to reconstruct and equip such tramways for electric traction, to lay down, construct, equip and maintain new electric tramways in connection therewith, to carry on in Bombay the business of tramway and railway proprietors, suppliers of electrical energy, carriers of passengers and goods, electrical engineers, electricians, contractors and manufacturers of electrical apparatus, to register the company in India in pursuance of the Indian Companies' Acts, &c. The first subscribers (each with one share) are:—C. S. B. Hilton, Donington House, Norfolk Street, W.C., managing director; E. Garcke, Donington House, Norfolk Street, W.C., managing director; C. H. Dade, Donington House, Norfolk Street, W.C., company secretary; C. W. G. Little, Donington House, Norfolk Street, W.C., engineer; Lord Vaux of Harrowden, Harrowden Hall, Wellingborough; E. Hopwood, Donington House, Norfolk Street, W.C., company secretary; and F. C. Rimington, c/o the Credit Lyonnais, Cockspur Street, S.W., managing director Bombay Tramway Co., Ltd. No initial public issue. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £500; remuneration, £2,000 per annum (£500 for the chairman and the balance divided between them). Directors' power of borrowing on debentures or debenture stock limited to amount of nominal capital. Registered office, Donington House, Norfolk Street, Strand.

Dewsbury Electric Manufacturing Co., Ltd. (85,100).—This company was registered on July 1st, with a capital of £5,000 in £1 shares, to acquire the business of friction, derrick and locomotive crane overhead traveller makers, machinery merchants and general engineers carried on at 22, Listerhills Road, Bradford, and elsewhere, as "Roberts & Kaye," to adopt an agreement with C. H. Kaye, W. G. Thomson and J. Bentley, and to carry on the said business and that of electrical engineers, manufacturers of and dealers in electric, magnetic, telegraph, telephonic and other appliances and apparatus, &c. The first subscribers (each with one share) are:—C. H. Kaye, 20, Chesham Street, Bradford, mechanical engineer; W. G. Thomson, 37, Waverley Road, Bradford, mechanical engineer; J. Bentley, 11, Grange Road, Bradford, builder and contractor; W. Fowler, 128, Salisbury Terrace, Bradford, electrical engineer; H. Green, Westfield, Bradley, Keighley, electrical engineer; Miss A. M. Bentley, 11, Grange Road, Bradford; and J. C. Whitaker, 9, Heath Road, Bradford, clerk. No initial public issue. The first directors are J. Bentley (managing director), W. G. Thomson, C. H. Kaye and H. Green; qualification, £150. Registered office, Engineering Works, Kilpin Hill, Heckmondwike.

Caracas Electric Tramways Co., Ltd. (85,073).—This company was registered on June 28th, with a capital of £25,000 in £1 shares, to acquire concessions, rights and privileges for the construction of tramways, light or other railways, or systems of communication or conveyance in Venezuela or elsewhere, and to carry on the business of tramway and railway proprietors, carriers of passengers and goods, electrical engineers and contractors, electricians, manufacturers of and dealers in railway, tramway, electric, galvanic, magnetic and other apparatus, &c. The first subscribers (each with one share) are:—J. E. Gunyon, North Cray, Kent, secretary; E. C. Smith, 1, Crichtons, Romford, clerk; P. J. V. Capern, Kingswood, Stradella Road, Herne Hill, S.E., clerk; F. H. Burr, 9, Trinity Avenue, Southend, secretary; W. R. Jones, 2, Tenby Villas, St. Stephen's Road, Hounslow, clerk; S. V. Lewis, Honeglade, Park Road, Forest Hill, S.E., clerk; and A. S. Wigmore, 5, Benson Road, Forest Hill, S.E., clerk. No initial public issue. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first; qualification, one share; remuneration as fixed by the company.

CITY NOTES.

Chili Telephone Co.

THE report of the directors for the year ended March 31st, 1905, to be presented at the ordinary general meeting on the 13th inst., states that the gross revenue in Chili from all sources was $978,746, showing an increase of $62,204. The expenditure in Chili was $445,140, an increase of $22,731. The net income in Chili from all sources was $533,606. The average rate of exchange for the year was 16·30d., as compared with 16·36d. in the previous year, giving a decrease for the year of 0·06d. Converted into sterling at this rate, the net income was £36,227, an increase of £2,540. The liquid assets and liabilities in Chili on March 31st, 1905, were valued at 16⅛d., the current rate of exchange on that day, as compared with 16⅝d., at which they were valued on the corresponding date of the previous year. The balance to the credit of the revenue account, including £2,502 brought from the previous year, is £34,547, of which £15,360 has been carried to reserve for renewal of plant, &c. An interim dividend of 3s. per share, less income-tax, was paid on January 14th last, and the directors now recommend a final dividend of 5s. per share, less income-tax, leaving a balance of £2,467 to be carried forward. The total mileage was on March 31st, 1905, 10,759 miles 1,658 yards, an increase of 875 miles 1,190 yds. In accordance with the articles of association, the Hon. Herbert T. Allsopp retires from the board of directors, and, being eligible, offers himself for re-election. The auditor, Mr. Thomas A. Welton, also retires and offers himself for re-election.

Edmundson's Electricity Corporation.

THE directors' report for the year ended March 31st, 1905, says that, including the sum of £13,924 brought forward from last year, the net profit, after payment of debenture interest, amounts to £68,916. After deducting dividends on preference shares paid and accrued, amounting to £22,007, and an interim dividend at the rate of 5 per cent. per annum on the ordinary shares, amounting to £8,750, there remains a balance of £38,159, which the directors recommend should be appropriated as follows:—

Final dividend on the 70,000 ordinary shares at the rate of 9 per cent. per annum, making 7 per cent. for the year	£15,750	0	0
Dividend at the rate of 7 per cent. on 10,000 ordinary shares issued in November, 1904	766	0	0
Reserve fund	6,635	9	11
Carried forward	15,007	6	7
	£38,158	16	6

The trading profit for the first time shows a small decrease, but, on the other hand, the income derived from investments has considerably improved. It is on a continuance of this improvement that the progress of the corporation will in future mainly depend. During the year 10,000 preference shares, 10,000 ordinary shares, and £37,804 debenture stock have been issued. The premiums received in respect of these issues, less expenses, amount to £13,365 and have been added to the reserve fund, which, with the contribution proposed to be made from revenue account, will be thereby increased to £90,000. The growth of the electric lighting and power stations in which the corporation is interested continues to be satisfactory, the lamp connections having increased from 568,549 to 761,453 during the year. The central station at Newbury was completed and opened in January. Good progress has been made in connection with the central stations at Inverness and Ramsgate, both of which will be opened during the next few months. These will complete the whole of the central stations which the company at present proposes to erect.

Greenwood & Batley.

The seventeenth ordinary general meeting of this company was held at 16, Gt. George Street, Westminster, on Saturday last, Mr. Arthur Greenwood in the chair.

In moving the adoption of the report (Electrical Review, Vol. 56, p. 1069), the Chairman said that he must congratulate the shareholders upon its satisfactory character. There was a further increase of £6,000 upon last year's report, due very largely to important orders received during the latter part of the year, and which were completed within the specified time. The result of the year's trading, together with the carry over from last year, left them with £35,859 to deal with, and out of that the directors had devoted £7,500 to depreciation. That was an increase over the amount allotted to depreciation last year, and they thought it was advisable, because they had turned out a lot of old plant to make room for more improved plant. The sum of £5,000 had been added to the reserve account—bringing it up to £35,000. The dividend proposed on the ordinary shares was 6 per cent., in place of 5 per cent. The directors intended to continue their policy of paying a moderate dividend upon the ordinary shares until the financial position of the company had been strengthened. The dividends and provisions absorbed their available funds with the exception of £6,026, which they proposed to carry to the next account, and that was over 50 per cent. more than was carried over in any previous year. The shareholders would remember that last year they did not add to the reserve account, but wrote off the sum of £5,000 for their investments in affiliated companies. He was pleased to say that the directors considered the figures at which those investments now stood—£37,625—was a justifiable one, and they did not propose to alter it. The principal company in those investments was the de Laval Steam Turbine Co. They had spent a great deal of money in the development of that steam turbine, and they were now making substantial progress. The experimental stage was passed, and the sales of the turbine were steadily increasing. The slight profit made during the year before last had been considerably increased, and he looked forward with great confidence to that business. Referring to the Russian Engineering Co., the chairman remarked on the state of that country, and said that as matters must at some time become more settled, he hoped that brighter prospects were in store. In conclusion, he said that the company's central electric station was now practically completed. They had 800 h.p. entirely consisting of de Laval turbines, and the result had fully justified the expenditure.

The motion was seconded by Major-General E. Micklen, and carried.

Birmingham and Midland Tramways Co.

The directors state in their report that the total revenue for the year, including £695 brought forward from the previous account, amounts to £108,626, and, after deducting expenses chargeable to revenue (including repairs and maintenance), there remains £35,948. Deducting interest on the debenture stock and the dividend on the 5½ per cent. preference shares, amounting together to £14,996, there is an available balance of £20,951, which the directors propose should be applied as follows:—To payment of a dividend on the preferred ordinary shares at the rate of 5½ per cent. for the year ended December 31st, 1904, £19,250; to be carried forward to next account, £1,701. The traffic receipts have suffered during the past year by reason of the dislocation of traffic brought about by the reconstruction of the lines for electric traction. The work has, however, now been completed, and the receipts have materially increased. The expenditure on capital account during the past year amounted to £160,913, including outlay on the reconstruction of lines, the erection of a power house and transforming stations, the purchase of cars, &c. The balance of the outstanding debentures of the old issue, amounting to £9,900, was paid off in May, 1904. An issue of £200,000 4½ per cent. first debenture stock was made in June last, in order to provide in part for the reconstruction expenditure. A further amount of stock has recently been issued, and will appear in the accounts for 1905. The subscribed share capital and debenture stock of the company as on December 31st consisted of 20,978 5½ per cent. fully-paid preference shares of £10 each, 35,000 fully-paid 7 per cent. preferred ordinary shares of £10 each, 35,000 fully-paid deferred ordinary shares of £10 each, and £200,000 4½ per cent. debenture stock. The total route mileage of tramways operated by the joint committee is 98½, of which 79¾ are electric, and the remainder are worked by cable, steam and horses, while there are 13¾ miles of tramways and light railways for which powers have been obtained, but which are not yet constructed.

United River Plate Telephone Co.

The nineteenth ordinary general meeting of this company was held on Tuesday at Winchester House, Mr. J. Irving Courtenay presiding.

In moving the adoption of the report (Electrical Review, Vol. 56, p. 1070), the Chairman said that since he last addressed the shareholders he had been to South America and had carefully inspected all the principal properties and stations of the company in Buenos Ayres, Rosario, Cordoba, La Plata, and elsewhere, and as the result of his investigations he was able to give the shareholders the assurance that the company was firmly rooted. The progress of the company during the year under review was shown by the increase in the number of subscribers in the Buenos Ayres section, which had been considerably in excess of that of any previous year. The revenue had increased proportionately, although the net revenue had not increased in quite the same ratio because expenses of all kinds had materially advanced in the River Plate during the year. The capital of the company had been increased by £60,000 by the issue of 12,000 new ordinary shares in June, 1904. Sundry creditors were £10,874 less than the previous year. A further sum of £10,000 had been put aside for renewal of plant, while £15,000 had again been added to the reserve fund. On the credit side of the balance-sheet they had the additional capital outlay for the year—£52,501 12s. 10d. The increase in subscribers had rendered necessary the incurring of an expenditure for instruments, lines, underground plant, &c. Sundry debtors stood at £5,540, but that sum included a large marine insurance claim for copper wire lost in transit through the foundering of a vessel. The company's real estate had been increased by £6,040, and their securities at cost showed an increase of £11,690. The profit and loss account showed that the receipts in the River Plate had increased by £16,260, while maintenance charges and general expenses were £12,057 higher than during the previous year. The latter increase was due to somewhat exceptional circumstances, for they had renewed and greatly improved some of their more important trunk lines entirely out of revenue, and they had also had to suffer an unusually large amount of damage occasioned by storms. The balance of profit for the year was £2,448 in excess of the preceding year, and the directors were thus able to recommend a final dividend of 5 per cent. on the ordinary shares, making with the interim dividend a return of 8 per cent. for the year, free of income-tax. As was stated in the report, the directors intended to make an immediate issue of £50,000 in ordinary shares, which would be offered to the ordinary shareholders at par.

The report was adopted.

Tramcar Manufacturers' Combine.

According to a correspondent of the *Financial Times*, the acquisition by the Electric Railway and Tramway Carriage Works, Ltd., of Preston, of the Castle Car Works (late G. F. Milnes & Co., Ltd.) of Hadley, Salop, and the British Electric Car Works, of Old Trafford, Manchester, has now been completed. It has been decided to raise the share capital of the Preston company to £300,000 by the creation of 150,000 6 per cent. cumulative preference shares of £1 each, and to change the name to the United Electric Car Co. The debenture capital remains at £50,000, but the £5 ordinary shares are to be split into £1 shares.

The Castle and the British Works recently went into liquidation. Their works were then offered for sale, and were purchased jointly by the Metropolitan Amalgamated Railway Carriage and Wagon Co., Ltd., and by representatives of the Preston Works and Messrs. Dick, Kerr & Co., namely, Messrs. John Kerr, George Flett and William S. Laycock. These purchasers have now resold the two works to the United Co. for, it is stated, £85,000. In order to provide the purchase money and £15,000 for additional working capital, the directors of the United Electric Car Co. are about to issue 100,000 of the new preference shares; 75,000 will be offered to the share and stock holders at par, and 25,000 are being taken at par by the Metropolitan Amalgamated Carriage and Wagon Co.

In the opinion of the directors, the serious drop in the profits of the Electric Railway and Tramway Carriage Works for the year ended June 30th, 1904 (when only 5 per cent. dividend was paid on the ordinary shares), was chiefly due to severe competition and the cutting of prices. The acquisition of the above-mentioned concerns will, they consider, not only lessen the competition, but should also enable the United Co. to largely increase its own output. Two gentlemen connected with the Metropolitan Amalgamated Railway Carriage and Wagon Co. have been nominated directors of the United Co.

The Electric Construction Co.

The report of the directors, to be submitted to the shareholders at the annual general meeting, to be held on Thursday next at Winchester House, Old Broad Street, E.C., at 12.30 p.m., states that the net profit of the year is £3,908 14s. 3d., and, adding £3,805 3s. brought forward from last year, the amount available for distribution is £7,713 17s. 3d. The directors recommend that a dividend at the rate of 7 per cent. per annum be paid on the preference shares, absorbing £4,394 12s., and leaving a balance to be carried forward to next account of £3,319 5s. 3d. The buildings and plant have, as formerly, been thoroughly maintained out of revenue, and £5,000 has been credited to depreciation account. The latter account now amounts to £58,000, and the general reserve fund to £32,000. The competition referred to in the last report has been intensified during the year, and still continues, but there are signs of improved trade in the near future; meanwhile every effort is being made to meet by economy and improved administration the low prices now current. The directors who retire at the annual general meeting are Sir James Pender, Bart., and Mr. Philip Edward Beachcroft. They are eligible for re-election. The auditors, Messrs. James Meston & Co., offer a renewal of their services.

The Electric and General Investment Co.

The 16th ordinary general meeting of this company was held on Wednesday at Winchester House, Mr. George Herring in the chair.

In moving the adoption of the report (Electrical Review, Vol. 56, p. 1029), the Chairman said that last year he was rather doleful when he addressed them, but this year he thought that there was reason to be cheerful. It was true that there was a decrease in the profits of some £2,600, but things were not so bad as they looked. The capital account remained the same. The loan account stood at £46,000, against £122,000 for the previous year, and £309,000 the year before that. They had, therefore, greatly reduced that item. The loan account on behalf of clients was much smaller, but that was not so satisfactory, as it meant less business done. Sundry creditors stood at £56,361, and the balance of profit and loss account was £4,276. The investments of the company had progressed very favourably, and they had sold some at an advantage.

The report was adopted, and it was agreed to pay a dividend of 4s. per share on the ordinary shares for the year and £20 per share on the founders' shares, which, with the £10 per share out of dividends received on the trust investments, would make a total distribution of £30 on each founders' share for the year.

Mr. Emile Garcke was re-elected on the board, and the proceedings terminated with a vote of thanks to the Chairman.

Electrical Power Storage Co.

The report of the directors to be presented to the shareholders at the ordinary general meeting, to be held on Thursday next at the offices of the company, at 2.30 p.m., states that the profit for the year ending May 31st, including the balance of £470 17s. brought forward, is £9,600 14s. 8d. Out of this sum the directors have carried £1,000 to the contingent fund, and set aside £2,500 for depreciation of patents, goodwill, &c. They recommend again the payment of a dividend of 6 per cent. on the ordinary share capital, which will absorb a further £5,389 13s. 7d. and leave £711 1s. 1d. to be carried forward. In addition to the £2,500 set aside as above, the directors have transferred £13,500 from the special reserve account, making £16,000 in all, which has been applied in reduction of patents, goodwill, &c. This leaves £10,000 at the credit of special reserve to provide for possible diminution in the value of the assets, for repayment of debentures, &c. The buildings, plant, tools, &c., have been maintained in thorough repair and condition at a cost of £3,540 18s. 4d., which sum has been provided out of revenue. The directors are glad to record another satisfactory year, notwithstanding the continued industrial depression and increased keenness of competition. The retiring director is Mr. Frederick Green, who offers himself for re-election. The auditors, Messrs. James Meston & Co., chartered accountants, also offer themselves for re election.

Marconi's Wireless Telegraph Co.—An extraordinary general meeting will be held on the 11th inst. to consider a resolution to increase the capital of the company to £500,000 by the creation of 200,000 further shares of £1 each. It is also proposed to make certain alterations in the articles of association.—*Financial Times.*

Barcelona Tramways Co.—A contract has been entered into, subject to the approval of the shareholders, for the sale of the company's undertaking at a price which, including accrued profits to June 30th last, will permit, after paying off the debentures, debenture stock, and preference shares with interest, of a return to the ordinary shareholders of approximately £14 per share. An extraordinary general meeting of the company will be called in the course of a few days to submit the agreement for approval.—*Financial News.*

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in, and to grant a quotation to—

County of Durham Electrical Power Distribution Co., Ltd.—50,000 ordinary shares of £5 each, and 50,000 preference shares of £5 each (special application).
Hastings and District Electric Tramways Co., Ltd.—£125,000 4½ per cent. debenture stock.

The Stock Exchange Committee has ordered the following securities to be quoted in the Official List:—

British Electric Traction Co., Ltd.—Further issue of £415,422 5 per cent. perpetual debenture stock, and £160,178 4½ per cent. second debenture stock.
Eastern Extension, Australasia and China Telegraph Co., Ltd.—Further issue of £150,000 4 per cent. mortgage debenture stock (perpetual).
Potteries Electric Traction Co., Ltd.—Further issue of £25,000 4½ per cent. debenture stock.

The Electric and General Investment Co.—The warrants for the half-year's dividend, payable July 1st, on the 6 per cent. cumulative preference shares of this company have been posted.

Cape Electric Tramways.—An interim dividend of 2½ per cent., free of tax, has been declared.

South Metropolitan Electric Light and Power Co.—Allotment letters in respect of debenture stock, and also of the ordinary and preference shares, offered for subscription on the terms of a circular dated June 23rd, 1905, have been posted. The ordinary and preference shares were very largely over-subscribed by the existing share and debenture stock holders.

STOCKS AND SHARES.

Wednesday evening.

With the half-yearly dividend money coming into the Stock Exchange, investment markets all round received a fillip, although, on the whole, prices did not respond so readily to the demand as is usually the case.

Electricity Supply securities, for instance, cannot boast a single advance on the week, but, on the other hand, Telegraph descriptions show a good sprinkling of rises, and in one or two cases stocks have recovered the whole of the dividend. Anglo-American 6 per cent. Preference is a point better at 106½-107½, but the Deferred has slipped back ⅛ to 14⅞-15. Cuba Preferences have risen ½ to 17-18 on a small demand. Great Northern Telegraphs are the same price *ex* dividend as they were *cum* dividend—viz., 33-34—and the same may be said of Westerns at 13½-14 *ex* dividend. National Telephone Preferred stock was wanted, and is ½ per cent. up at 112.

Underground Electric Railways have enjoyed a little activity. Baker Street and Waterloo Debentures were in fair demand at about 6 premium, and Great Northern and Charing Cross issues were also in some request. The mishaps on the Inner Circle last Saturday, the first day's running of the electrified trains, had little or no effect on the prices of the stocks. It must not be forgotten that many people who would not travel on this railway before, owing to the objectionable fumes, will now be returning, and, therefore, the increase in the traffic receipts should go up by leaps and bounds. Take, for instance, the Metropolitan line, where an increase of 25 per cent. in the gross traffics would increase the dividend by 3 per cent., making it a 6 per cent. stock.

Again, an increase of 50 per cent. in the gross traffics of the District would enable the company to pay the interest on all the pre-Ordinary stocks in full and give 1½ to 2 per cent. on the Ordinary stock.

As regards the City and South London, the market is going for a reduction in the dividend owing to the competition of tramcars on the South side of the river. It will be remembered that the electric tramways to Clapham were opened in May, 1903, and those to Streatham on July 1st, 1904, so that we have now seen the worst of the tramway competition as regards the City and South London. The Northern extension from the Angel to King's Cross and Euston is in course of construction. As this extension will bring the line into communication with the three most important trunk lines, namely, the North-Western, Midland and Great Northern, we think, when the extension is completed, the line will have a bright future before it.

As regards Electrical Manufacturing concerns, there is little of interest to be noted. Telegraph Constructions have fallen a point to 31-33. The dividend on Electrical Power Storage Ordinary shares for the year ended May 31st is 6 per cent. A year ago the dividend was at the same rate.

As we said above, there are no movements to record in Electricity Supply shares. The market at the moment is inclined to be tender, as the "Administrative County of London Bill" is up before the House of Commons this week.

We understand the new issue of South Metropolitan Electric Ordinary and Preference shares was over-subscribed for to some extent.

An interim dividend of 2½ per cent. on Cape Electric Trams has been declared. The price is steady round about 1⅞.

The capital of the Urban Electric Supply Co. is to be increased to £650,000 by the creation of 30,000 new Ordinary shares of £5 each, to rank *pari passu* with the existing Ordinary shares. A resolution to this effect was passed at a meeting of share and debenture-holders held on the 5th inst. The shares are not likely to be issued for some time to come.

The report of Edmundson's Electricity for the year ended March 31st, 1905, shows that the company is continuing to make excellent progress. The profit for the year is, roughly, £68,800, as against £63,800 odd for the corresponding period of last year, whilst income from investments amounts to over £30,000, as against nearly £19,000. About £4,000 less has been written off, which, however, is accounted for by the fact that the capital is much bigger this year than last, and therefore considerably more had to be paid away in interest and dividends. The shares are unchanged in price, both the Ordinary and Preference keeping steady at 5⅞-6⅛ and 6¼ respectively.

Eastern Extension, Australasia and China Telegraph Co.—The directors have declared an interim dividend for the quarter ended March 31st of 2s. 6d. per share, free of tax, payable on the 15th inst.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1902.	1903.	1904.	Closing Quotations June 28th.	Closing Quotations July 5th.	Business done week ended July 5th, 1905. Highest	Lowest.
34,800	African Direct Telegraph, 4 % Debs.	100	4 %	4 %	4 %	100 —103	98 —101 xd	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	2¼— 2⅜	2¼— 2⅜	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	89 — 94	70 — 75	..	..
763,580	Anglo-American Telegraph	Stock	60/6	61s.	2⅜%	59 — 61	59 — 61	..	..
3,118,210	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5¾%	105½—106½	106½—107½	107½	106½
3,118,210	Do. do. do. Deferred	Stock	1/-	2s.	Nil	14⅝— 15⅜	14⅝— 15	15 5/16	14⅝
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	6⅞— 7⅛	6⅞— 7⅛	7 1/16	7
15,000,000$	Commercial Cable	$100	8 %	8 %	8 %	..	..	..	..
1,932,856£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	4 %	4 %	4 %	97½— 98⅛	96½— 98⅛ xd	97⅝	96¾
16,000	Cuba Telegraph	10	6¼%	10 %	5 %	8 — 8½	8 — 8½	..	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	16½— 17½	17 — 18	..	..
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	3⅝— 3⅞	3⅝— 3⅞	..	..
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	9 — 9½	9 — 9½	..	..
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	102 —104	100 —103 xd	..	..
60,710£	Direct United States Cable	20	3¼%	3 %	..	11⅛— 11⅜	11⅛— 11⅜	11⅜	11¼
74,500	Direct West India Cable, 4½ % Reg. Deb., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	101 —103	99 —101 xd	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	141 —144	141 —144	143½	141½
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	..	90 — 92	90 — 92	91⅝	90⅝
1,836,514	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	107 —109	107 —109	108⅜	106⅝
300,000	Eastern Extension, Australiasia, and China Telegraph	10	7 %	7 %	7 %	13⅜— 14⅛	13⅜— 14⅛	13 15/16	13⅜
602,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	105½—107½	105½—107½	..	..
300,000	Eastern & South African Tele., 4 % Mt. Db., Nos. 1 to 3,000, red. 1909	100	4 %	4 %	4 %	100½—102½	100½—102½	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	100½—102½	100½—102½	102	..
180,887	Globe Telegraph and Trust	10	£3 16 7*	5⅛%	5⅛%	10½— 10⅝	10½— 10⅝	10 5/8	10⅛
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	14½— 14⅝	14½— 14⅝	14 1/8	14⅛
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	15 %	24 %	33 — 34	33 — 34	..	..
46,500	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	101 —103	99 —101 xd	99¼	..
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	49 — 51	49 — 51	50½	49
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	3 %	..	⅜— 7/8	⅜— 7/8	..	..
1,983,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	111 —112	111½—112½	112⅝	111½
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	102 - 104	102 —104	103¼	102¼
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 13	12 — 13	12⅛	..
250,000	Do. do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5½ — 5⅝	5½ — 5⅝	..	..
2,000,000	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	101 —103	99 —101 xd	99⅝	..
1,689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	103½—105½	101½—103½ xd	102⅝	..
179,313	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6¼%	6¼%	1⅜— 1⅝	1⅜— 1⅝	1 3/32	1 1/16
50,000	Do. do. do. 6 % Cum. Pref.	1	6 %	6 %	6 %	1 7/8— 1 15/16	1 7/8— 1 15/16	..	..
100,000	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	99 —102	97 —100 xd	..	..
11,839£	Reuter's	8	5 %	5 %	5 %	7½— 8	7½— 8	..	..
3,237	Submarine Cables Trust	Cert.	6 %	6 %	6 %	125—128	125—128	..	..
58,000	United River Plate Telephone	5	7 %	8 %	8 %	7 — 7½	7 — 7½	7 7/8	7¾
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 — 5¼	5 — 5¼ xd	5⅜	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	108 —110	106 —108 xd	..	..
15,609£	West African Telegraph, Shares	10	2 %	4 %	4½%	8½— 9 xd	8½— 9	..	..
30,008	West Coast of America, 1 to 30,000 and 53,001 to 53,008	2½	Nil	Nil	Nil	1/16— 1/16	1/16— 1/16	..	..
150,000	West Coast of America, 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	100 —102	99 —101 xd	..	..
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930	10	7 %	7 %	7 %	13½— 14	13½— 14 xd	13⅝	13 9/16
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	102 —104	100 —102 xd	..	..
563,380	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	103 —105	101 —103 xd	102½	..
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	½— ⅝	½— ⅝	..	..
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	7 %	7 %	6 %	8 — 8½	8 — 8½	8⅝	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	5⅝— 6¼	5⅝— 6¼	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	103 —105	101 —104 xd	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

40,000	British Aluminium 7 % Cum. Pref.	5	Nil	Nil	Nil	4⅜— 5⅛	4⅜— 5⅛	..	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	Nil	4⅜— 5⅛	4⅜— 5⅛	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	..	2¾— 3¼	2¾— 3¼	..	..
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	100 —104	100 —104	..	..
133,301	British Electric Traction	10	8 %	6 %	..	9¼— 9⅜	9¼— 9⅜	9⅜	9⅜
156,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	..	11¼— 11⅜	11¼— 11⅜	11 7/16	11⅜
1,000,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	5 %	5 %	5 %	122 —124	122 —124	122⅛	..
250,000	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	97 — 99	98 —100	98⅛	98¼
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	5¾— 6	5¾— 6	5⅝	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	5¾— 6	5¾— 6	5⅝	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	103 —106	101 —104 xd	102½	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	11/16— 13/16	11/16— 13/16	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	Nil	Nil	½— ⅝	½— ⅝	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	1 — 1⅛	1 — 1⅛	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	4½%	4½%	4½%	92 — 95	92 — 95	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	79 — 82	77 — 80 xd	..	..
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	10 — 11	10 — 11	10½	..
40,000	Do. do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5⅜— 5⅝ xd	5⅜— 5⅝	5⅝	..
300,000	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	106 —108 xd	106 —108	107½	..
1,963,208	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	90 — 92	90 — 92	91½	..
523,396	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	101 —103	101 —103	102	..
523,396	Do. do. Def. do.	Stock	4 %	4 %	4 %	78 — 81	78 — 81	..	..
1,330,000	City and South London Railway	Stock	3½%	2⅞%	2⅞%	39 — 41	39 — 41	40½	..
85,000	Crompton & Co., Nos. 1 to 85,000	3	5 %	2½%	..	1⅝— 2⅛	1⅝— 2⅛	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	95 —100	94 — 99 xd	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	Nil	Nil	..	1¼— 1⅜	1⅜— 1⅝	..	..
17,139	Do. do. "A" shares, 01—017,139	5	Nil	Nil	..	2 — 2⅛	2 — 2⅛	..	..
344,022£	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	84 — 89	83 — 88 xd	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	85 — 90	89 — 94	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	..	¾— 1	¾— 1	31/32	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	..	2⅛— 2⅜	2⅛— 2⅜	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	4 %	4 %	4 %	95 — 98	95 — 98	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9⅜— 10⅛	9⅜— 10 xd	..	..
200,000	Do. do 4 % Mort. Deb.	Stock	4 %	4 %	4 %	97 —101	97 —101	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	20 %	15 %	15 %	11¾— 12⅛	11¾— 12⅛	11⅞	..
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	5⅜— 5⅝	5⅜— 5⅝	..	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	109 —111	109 —111	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	15½— 16½ xd	15½— 16½ xd	..	..
300,000£	Do. do. 4 % 1st Mort. Deb.	100	4 %	4 %	4 %	100 —103	100 —103	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	13⅓%	13⅓%	11⅓%	9¾— 9⅞	9¾— 9⅞	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	9¼— 9⅜	9¼— 9⅜	..	..
37,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	32 — 34	31 — 33	32¾	31½
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	103 —105	101 —103 xd	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3⅛%	3⅛%	3⅛%	90 — 92	90 — 92	90	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 2½ per cent. (March 9th, 1905).

SHARE LIST OF ELECTRICAL COMPANIES *(continued)*.—ELECTRICITY SUPPLY COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1902.	1903.	1904.	Closing Quotations June 28th.	Closing Quotations July 5th.	Business done week ended July 5th, 1905. Highest	Lowest.
		‡							
29,377	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	5	8 %	10 %	10 %	9⅜ — 10½	9⅜ — 10½	..	..
10,623	Do. do. 7 % Cum. Pref. ..	5	7 %	7 %	7 %	9½ — 10¼	9½ — 10¼	..	..
288,782	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	103 —106	103 —106	..	..
80,000	Charing Cross and Strand Electricity Supply	5	10 %	8 %	8 %	7⅛ — 8	7⅛ — 8	7⅜	7⅛
80,000	Do. do. do. 4½ % Cum. Pref. ..	5	4½%	4½%	4½%	5⅛ — 5⅜	5⅛ — 5⅜	5⅛	5⅛
40,000	Do. do. " City Undertaking " 4½ % Cum. Pref. ..	5	4½%	4½%	4½%	5 — 5⅛	4⅞ — 5⅛xd	..	..
40,000	Do. do. 1903	5	..	4½%	4½%	5 — 5⅛	4⅞ — 5⅛xd	4⅛	..
350,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	105 —107 xd	105 —107	106	105
44,486	*Chelsea Electricity Supply, Ord.	5	4½%	5½%	6 %	6⅛ — 6⅝	6⅛ — 6⅝	..	..
150,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	109 —111	108 —110 xd	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595. ..	10	5 %	5 %	6 %	10⅜ — 11¼	10⅜ — 11¼	11	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	13¾ — 14¼	13¾ — 14¼	..	..
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	5 %	5 %	5 %	124 —128	122 —126 xd	..	..
300,000	Do. 4½ % 2nd Deb. Stock, Prov. Certs., all paid	100	4½%	4½%	4½%	104 —106	103 —105 xd	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	8¼ — 8⅝	8¼ — 8⅝	..	..
30,000	Do. do. do. 6 % Pref., 40,001—60,000 ..	10	6 %	6 %	6 %	12⅝ — 13⅛	12⅝ — 13⅛	..	..
400,000	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	113 —116	112 —115 xd	..	..
250,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	103 —105	103 —105	104½	104½
70,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	5⅞ — 6¼	5⅞ — 6¼	6	5⅞
80,000	Do. do. 6 % Cum. Pref.	..	6 %	6 %	6 %	6 — 6¼	6 — 6¼	6⅜	..
300,000	Do. do. 4½ % 1st Mort Deb. Stock	100	4½%	4½%	4½%	107 —109	107 —109	109	..
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	12 %	12 %	11½ — 12¼	11½ — 13½	..	..
136,000	Do. do. do. 4 % Debenture Stock ..	Stock	4 %	4 %	4 %	101 —103	101 —103	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	Nil	3 %	2 — 2¼	2 — 2¼	..	..
60,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	5 — 5¼	5 — 5¼	..	..
371,895	Do. do. do. 4 % 1st Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	99 —101 xd	98 —101	101	..
100,000	Metropolitan Electric Supply, 1 to 100,000	5	7½%	8½%	10 %	9¼ — 10	9⅜ — 10	9⅛	9¼
76,121	Do. do. 4½ % Cum. Pref. 1—71,106, £3 paid ..	5	4½%	4½%	4½%	5½ — 5⅝	5⅝ — 5⅝xd	5⅛	..
220,000	Do. do. 4½ % 1st Mort. Deb. Stock	..	4½%	4½%	4½%	111 —115	109 —113 xd	..	..
250,000	Do. do. 3½ % Mort. Deb. Stock Red.	Stock	3½%	3½%	3½%	99 —101	98 —100 xd	100½	99½
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	101 —103	99 —101 xd	100¼	100
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	14¼ — 15½	14¼ — 15½	..	..
59,090	Do. do. 4 % 1st Mort. Deb.	100	4 %	4 %	4 %	100 —102	100 —102	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	13¾ — 14½	13¾ — 14½	..	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	8¾ — 9	8¾ — 9	..	..
150,000	Do. do. do. 3½ % Deb. Stock Red. ..	100	3½%	3½%	3½%	97 — 99	97 — 99 xd	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	4 %	2⅝ — 3⅛	2⅝ — 3⅛	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	79 — 83	79 — 83	..	..
65,000	South London Electricity Supply, Ord.	5	1½%	3 %	4 %	3⅞ — 4¼	3⅞ — 4¼	3⅛	3⅞
100,000	South Metropolitan Electric Light and Power Ord. ..	1	Nil	Nil	Nil	⅞ — 1	⅞ — 1	..	..
50,000	(Late Blackheath and Greenwich 7 % Pref.	1	Nil	7 %	7 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..
100,000	Dist. E.L.Co.) 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	105 —108	105 —108	..	..
30,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	4⅝ — 4⅞	4⅝ — 4⅞	4⅝	4⅝
30,000	Do. do. 5 % Cum. Pref.	* 5	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..
200,000	Do. do. 4½ % 1st Mort. Deb. Stock Red. ..	100	..	..	4½%	104 —106	104 —106	105	..
110,000	Westminster Electric Supply, Ord.	5	12 %	13½%	14 %	12¼ — 13	12¼ — 13	12⅜	12¼
28,151	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	6⅜ — 6¼	6⅜ — 6⅜xd	6⅜	6¼

Shares not officially quoted :—Mackay Companies, ord., 39½—40½. Pref. 73½—74½.

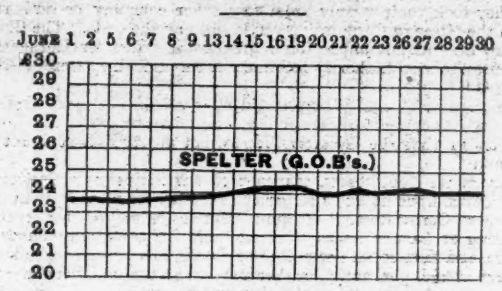
*Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

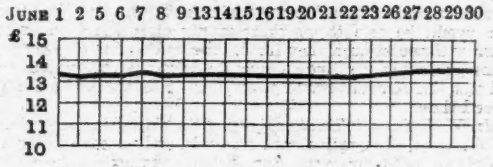
ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

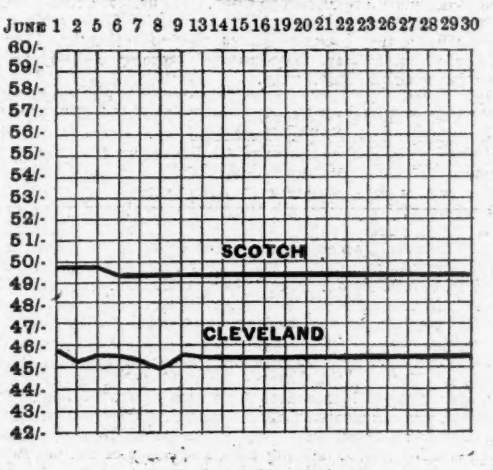
Locality.	Fortnight ended.	Receipts for the fortnight. £	* £*	No. of wks.	Total to date. £	* £*	Route miles open.	*
Aberdeen	July 1	3,102	+ 49	5	7,458	— 82	14·1	..
Ayr	June 25	704	— 15	6	1,870	— 99	8	..
Bath	" 28	1,509	+ 190	26	16,404	+ 1,343	13	..
Birkenhead	July 2	2,266	+ 32	13	13,932	— 211	13·5	..
†Blackburn	June 28	1,100	+ 110	13½	13,657	+ 648	14·25	..
Blackpool	" 29	3,334	+1,511	13	12,521	+ 1,243	11·87	..
" —Fleetw'd	July 1	1,773	+ 290	26	9,812	— 180	8	..
" —Lytham	June 22	1,602	+ 753	34	7,608	..	7¼	..
Bolton	July 2	4,218	+ 435	14	26,652	+ 930	26	..
Bournemouth ..	June 28	2,860	+ 766	12½	15,217	..	12·5	..
Bradford	July 1	8,843	— 357	12	58,752	— 1,716	54	..
Brighton	" 2	2,187	— 31	14	13,363	..	9·5	..
Bristol	June 30	11,305	+ 720	..	..	..	28·5	..
Brit. Elec. Trac. Co.								
Airdrie	June 23	417	— 10	25	4,913	+ 9	8·5	..
Barnsley	" 23	371	— 30	"	3,980	— 119	3	..
Barrow	" 23	646	+ 324	"	5,409	+ 1,415	5·37	..
Birmingham (City)	" 23	‡13,084	+ 120	"	‡141,081	+ 8,746	14·5	..
Birmingham (Mid.)	" 23	‡4,741	+1,528	"	‡45,614	+ 7,296	12·25	..
Devonport ..	" 23	1,037	— 211	"	11,252	— 1,237	8·85	..
Dudley—Sto'rb'ge	" 23	2,527	+ 857	"	21,313	+ 1,121	21·25	..
Gateshead	" 23	1,971	— 126	"	22,217	+ 291	11·25	..
Gravesend, N'fleet	" 23	604	+ 28	"	5,315	— 625	6·5	..
Gr'n'k, Pt. Glsgw	" 23	1,513	+ 224	"	14,944	+ 1,983	7·25	..
Hartlepool	" 23	659	— 8	"	6,277	— 467	6·72	..
Kidderminster ..	" 23	398	+ 117	"	2,711	— 121	4·5	..
Merthyr	" 23	443	+ 22	"	4,739	— 205	2·9	..
Metropolitan ..	" 23	‡7,559	+4,594	"	‡56,410	+ 2,538	..	..
Middleton	" 23	960	+ 189	"	7,958	+ 369	8·5	..
Oldham — Ashton	" 23	1,286	+ 155	"	13,239	+ 108	9·13	..
Peterborough ..	" 23	414	+ 102	"	3,107	— 235	5·31	..
Poole	.. ..	..	..	..	..	..	3·75	..
Potteries	" 23	3,641	+ 251	"	41,543	+ 440	29	..
Rothesay	" 23	435	+ 78	"	2,251	+ 144	2·75	..
Sheerness	" 21	174	+ 18	"	1,572	+ 269	2·5	..
Southport	" 23	1,020	+ 342	"	7,072	— 248	8·17	..
South Staffs. ..	" 23	1,881	+ 466	"	17,350	— 562	13·87	..
Swansea	" 23	1,964	+ 899	"	15,092	+ 2,553	5·5	..
Taunton	" 23	127	+ 21	"	1,149	— 127	1·5	..
Tynemouth	" 23	831	— 27	"	5,977	— 1,035	3·75	..
Weston-s-Mare ..	" 21	501	+ 195	"	1,838	+ 209	3	..
Wolverhampton D.	" 23	1,110	+ 292	"	9,325	+ 74	14·75	..
Worcester	" 23	822	+ 150	"	7,118	+ 789	5·75	..
Wrexham	" 23	233	+ 14	"	2,461	— 242	4	..
Yorks. Wool. Dist.	" 23	1,647	+ 363	"	16,413	+1,259	17	..
**Burnley .. ..

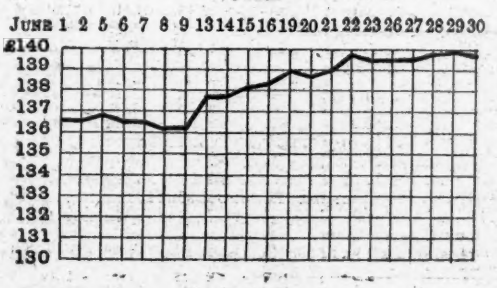
METAL MARKET.

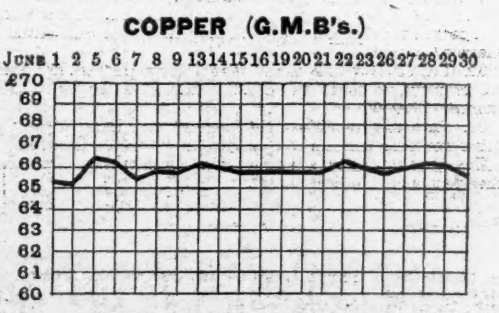
Fluctuations in June.











Witwatersrand (S. Africa). — A 650-H.P. electrical hoist, together with an engine and generator, for the new inclined underground shaft, is on order.

PARLIAMENTARY.

Surbiton Electric Lighting.

On Thursday, June 29th, Sir J. Woodhouse's Committee considered the Surbiton Electric Lighting Order in Confirmation Bill No. 6. The order was opposed by Mr. Hutchinson on behalf of the Kingston and Surbiton Gas Co.

Mr. Wedderburn, K.C., who appeared for the promoters, said that in 1901 Surbiton obtained an order which gave them an electricity area, which was the existing urban district of Surbiton. Since then there had been an extension of the urban district. In 1894 Southborough was added, and in 1895 Tolworth and Hook were added to the district. Those additions were the cause of this order, for it sought to make the electricity area of Surbiton co-extensive with the urban district. Under the order of 1901 nothing was done until 1902, as the Urban District Council did not wish to run any financial risks. In that year, 1902, they got a loan of £50,000 from the Local Government Board, but even then they did not think it right themselves to enter upon an electricity undertaking. Accordingly, they entered into an agreement with Callender's Cable and Construction Co., and by that agreement the Council were to provide the site for and erect the buildings of the generating station. The company were then to provide all the necessary plant and apparatus, and to provide the expenses of management, and also to pay the sinking fund and interest. The agreement was for 25 years. Practically it meant that the undertaking was leased to the company, and it would be seen that the arrangements were such that nothing could fall upon the ratepayers. The only opposition to the order was from the Gas Co., and it was really a question of whether or no the Bermondsey or Duke of Northumberland's clause should be inserted in the order. The Board of Trade, before whom the whole case had been argued out, had come to the conclusion that this was not a case where the clause should be inserted. The Committee would see that there was no chance of any loss falling upon the ratepayers.

Mr. Francis J. Bell, deputy clerk to the U.D.C., was then called, and cross-examined by Mr. Hutchinson, admitted that in reality, what had happened was that the Council had paid for the plant, and the company were really running the undertaking; and during the first two years were to pay the interest and sinking fund upon the machinery.

Mr. Hutchinson put it to witness that the Council were under the legal obligation to prepare themselves the annual statement of accounts, and that that power had been delegated to the company.

Witness said that the company did prepare the accounts.

In reply to a question by the Chairman, Mr. Wedderburn said that his contention was that this was a case where the Bermondsey clause was not applicable. The Urban District Council had never supplied electricity; it was the company which had done so. If the clause were put upon them, how could they work it? He knew that it might be said that a provision should be inserted so that the clause should be put in at any time that the Council decided to determine the agreement. But the answer to that was this: the Council would not determine the agreement unless there was a possibility of the result being profitable.

The Chairman remarked that it might not follow that the Council would manage the undertaking so well as the company had done. There might be a subsequent loss.

Mr. Wedderburn said that the clause was a hampering clause.

Mr. Bell, in reply to Mr. Wedderburn, said that up to the present there had been no loss on the undertaking. The Gas Co. were taking advantage of the fact that the Council were coming to ask for an extended area.

Mr. Hutchinson then addressed the Committee on behalf of the Gas Co., and dealt with the history of the Bermondsey clause. He cited as a case similar to this, the Watford Order. In the case before the Committee the District Council would, in five or seven years' time, or whenever they took over the undertaking, have to provide for the depreciation of the plant, for by that time much of the plant would have become obsolete.

Mr. Wedderburn, replying on the question of precedent, said that the Watford case was entirely different. There had been a loss for some years, whereas, in the present case, not only was there not a loss, but the Council had not been carrying on the undertaking themselves.

The Committee passed the preamble of the Bill, and ordered it to be reported for third reading.

St. Albans Electric Lighting Order.

On Thursday, June 29th, a Select Committee of the House of Commons considered the Bill confirming an electric lighting order to the St. Albans Rural Electric Lighting Co.

Mr. Moon, K.C., in opening the case, said that the only opponents to the order were the County Council of Hertfordshire, who asked for certain protection to be given to them. The County Council were the road authority, and they wished to have a protective clause in regard to their bridges.

At this point, Lord Robert Cecil, K.C., who appeared for the Hertfordshire County Council, conferred with Mr. Moon, and the latter counsel said he thought they could come to an agreement as to a clause. After further conferring, a protective clause was agreed

to, and the preamble of the Bill having been proved by Mr. Devonshire, the chairman of the St. Albans Rural Electric Lighting Co., the Committee confirmed the order.

Hessle Electric Lighting.

A Select Committee of the House of Commons, presided over by Sir James Woodhouse, on Wednesday and Thursday last week considered the order authorising the Hessle U.D.C. to supply electricity within their district. The confirmation of the order was opposed by the Hessle Gas Co.

Mr. Hutchinson, who appeared for the promoters, said that Hessle was an urban district on the Humber adjoining the City of Hull. It had an area of 2,111 acres, a population of 4,800 persons, a rateable value of £27,000, and a debt of only £6,482. The Bill was opposed by the Hessle Gas Co., which was a non-statutory company, and merely existed by the goodwill of the Urban District Council. As a matter of fact, by a Bill before Parliament, the old company would be dissolved in a few days, and a new company would come into existence. The gas supplied was bad, and that was one of the reasons why the Urban District Council came forward. In the Bill there was a clause stating that no loss should fall upon the ratepayers, so that he saw nothing for the Gas Co. to complain of. Clause 8 was the model clause put in by the Duke of Northumberland's Committee in several Bills, whereby no loss in the working of the electric light was allowed to fall upon the rates. At the end of 5 years the Urban District Council would have to take into review the position of the undertaking, and adjust the charges accordingly. The Gas Co. alleged in their petition that they had enlarged their memorandum of association, and would be prepared if there was a demand to obtain a provisional order themselves.

Mr. Appleton, Chairman of the Urban District Council, was called in support of the Bill, and said the Hull Corporation were willing on suitable terms to supply energy in bulk. The "Bill for the Supply of Electricity" was now before Parliament, and if that passed, Hull Corporation would be able to supply them. If that Bill did not pass, then the Hull Corporation would go before Parliament with a Bill to give them the necessary power.

In cross-examination by Mr. Ram (who appeared for the Gas Co.), Witness said they hoped to supply at 6d. per unit. It was true that the Urban District Council had tried to buy the gas undertaking, but he did not see that it would depreciate the value of the gas undertaking if the U.D.C. obtained the order.

Mr. Millington, chairman of the Electric Lighting Committee of the Hull Corporation, said he believed the undertaking would be remunerative in Hessle. Electricity was supplied at 4½d. per unit in Hull for lighting, and 1d. per unit for power.

Mr. Bell, electrical engineer to the Corporation of Hull, said he estimated that about 63,000 units per annum would be sold in Hessle for private buildings.

In reply to Mr. Ram, Witness said that Hull could supply Hessle in bulk at 3½d. per unit. In his estimate of 63,000 units, he included street lighting.

Several local witnesses were called in support of the Order.

Mr. Ram addressed the Committee on behalf of the Gas Co., and submitted that a Bill of this character had never been allowed by Parliament. The Gas. Co. had gone carefully into the question of applying for a provisional order for electric lighting themselves, and had satisfied themselves that it could not be done remuneratively. Notwithstanding this, the U.D.C. asked for powers which would cut the Gas Co. in two ways—they would limit their supply and largely affect them as ratepayers. If the Committee passed the preamble, he would ask that Clause 8 should be amended, so as to shorten the period at which the financial position of the undertaking should be reviewed.

The Committee decided to allow the Bill to proceed, subject to what might be done with Clause 8. On Thursday, after discussion, the Committee ordered the insertion of the Bermondsey Clause in its ordinary form.

Rutherglen Electric Supply.

On Tuesday, Wednesday and Thursday last week, Sir James Woodhouse's Select Committee of the House of Commons considered the Bill, by which the Corporation of Rutherglen sought to obtain confirmation of a provisional order to allow them to take a supply of electricity from the Corporation of Glasgow, upon terms to be agreed by the Board of Trade.

Mr. Balfour Browne, K.C., in opening the promoters' case, said that the majority of the clauses were the ordinary clauses to be found in provisional orders. Clause No. 7, by which it was provided that the undertaking might at any future time within one year be taken over by the Corporation of Glasgow, was opposed by the Clyde Valley Electric Power Co. Mr. Browne said that for a long time past the Borough of Rutherglen had desired to have a supply of electricity, and they had placed themselves in communication with the Corporation of Glasgow and also with the Clyde Valley Electric Supply Co. They had found that they could get a cheaper supply from the Corporation than they could get from the Supply Co., and as a matter of fact, the company up to the present time had not been able to supply at all. After further considering the matter, the Borough Council decided to apply for a prov. order.

Provost Roger was called in support of the Bill, and said it was contended by the Clyde Valley Electric Power Co. that a competition would be set up between the company and the Glasgow Corporation in Rutherglen, and they complained that the Corporation supply would be rate aided.

In cross-examination by Mr. Lloyd, K.C. (who appeared for the Clyde Valley Co.) he said it was not proposed to generate for themselves. The Glasgow Corporation was paying the costs of the promotion of the order. If the burgh took the Bill and generated themselves the Glasgow Corporation would still pay the costs, but if they took their supply from any other company or authority then the Glasgow Corporation would not pay the costs. The Clyde Valley Co. did not apply for a provisional order for Rutherglen because the local authority informed them that they were seeking an order.

In re-examination, Witness said they considered whether they could get a supply more cheaply from the company, and came to the conclusion that the Glasgow Corporation was the cheapest source of supply.

Mr. A. W. McFarlane, convener of the Lighting Committee of the Town Council of Rutherglen, said he negotiated with the Glasgow Corporation. Glasgow offered to supply for general lighting at 6d. per Board of Trade unit for a certain number of hours, and then at 1d. per unit; for domestic consumers a uniform charge of 3½d. per unit; for theatres and halls a uniform charge of 3½d.; for churches, 3d.; and for street lighting the same as in Glasgow. The offer of the Clyde Valley Co. was much dearer. If they obtained the order they were not bound to hand it over to Glasgow.

In cross-examination, Witness said the Town Council of Rutherglen would be free to get their supply elsewhere than from the Glasgow Corporation if they liked. He had no knowledge that the terms quoted by the Clyde Valley Co. were their maximum prices, and that the company stated that their prices would certainly not exceed these.

Mr. W. W. Lackie, chief engineer of the electricity department of the Glasgow Corporation, said it would only mean laying about 220 yds. of mains to supply Rutherglen, and they could give such a supply in about 14 days. Glasgow charged 6d. for the first 365 hours, and 1d. per unit afterwards, but the Glasgow Corporation were considering a reduction in price. He believed that the Clyde Valley Co. had mains laid within 5 miles of Rutherglen, and it would take them at least two months to give Rutherglen a supply.

In cross-examination, Witness said there were no distributing mains at present in Rutherglen.

Mr. Lloyd, K.C., addressed the Committee on behalf of the Clyde Valley Electric Power Co., which, he said, came into existence under an Act of 1901. Rutherglen was within the district of the company, and the company had the right of supplying to all persons for power purposes and the privilege of supplying in bulk to any authorised distributor in the district. He agreed that he was not entitled to oppose the Rutherglen local authority obtaining an order to generate, supply and use electrical energy, but he did oppose Clause 7, which enabled that order to be transferred to the Glasgow Corporation. As a matter of fact, this was simply an application to allow the Glasgow Corporation to supply the district. Instead of coming boldly to Parliament and asking for the power, the Glasgow Corporation was trying to get into the district by a side wind. He did not suggest for a moment that his company had a monopoly, and it was open to Parliament to allow others to compete. He did claim, however, that there was no necessity for any such competition, and that no case was made out. It was admitted that his company could give a supply within two months, and they had also offered to supply for public lighting at £10 per lamp, and for private lighting at a maximum of 6d. per Board of Trade unit with a reduction for long hours use.

The Chairman said that apart from the merits of the case, it appeared to him that by Clause 7 Rutherglen would be shut out of all possibility of changing their minds.

Mr. Lloyd said it shut him out of the market altogether. If the Bill passed with Clause 7, he would still have the power of competing with the Glasgow Corporation for power purposes, but the bulk supply would be in the hands of the Glasgow Corporation. It was a little hard now that the company's capital was raised and they were about to reap some benefit to find a considerable number of their prospective customers cut off.

Mr. Robertson, of the firm of Strain & Robertson, engineers of the Clyde Valley Electrical Power Co., said the capital of that company was £600,000. They could supply Rutherglen from the Motherwell generating station, which was 10 miles away. A great deal of cable work had been done, and they could give a supply to Rutherglen by the end of August.

When the Committee sat on Thursday, June 29th, the Chairman asked if the Clyde Valley Electricity Supply Co. were prepared to give an undertaking to supply Rutherglen on the same basis as the Glasgow Corporation.

Mr. Harold Beveridge said that if the order were transferred to the company, no doubt they could undertake to supply on the same terms as Glasgow.

Mr. Macassay remarked that he did not know of any power which would authorise a company to accept such a transfer.

The Chairman then adjourned the consideration of the case for the attendance of other counsel.

London County Council (Tramways) Bill.

Mr. Kearley, reporting from the Committee in the case of the London County Council (Tramways) Bill, stated that a report from the Secretary of State for the Home Department was laid before the Committee and considered by them, and that after hearing the evidence of the Chief Commissioner of Metropolitan Police and other persons, the Committee were satisfied that the additional obstruction to the access to the Houses of Parliament which would

result from the construction and working of the proposed tramways would not be considerable and did not constitute a sufficient reason for refusing to grant the proposed powers. With the object of securing that the working of the proposed tramways over Westminster and Blackfriars Bridges, and along the Victoria Embankment, should involve the least amount of interference with the traffic using the roads on which such tramways would be laid, the Committee had determined that the position in the roadway of certain parts of such tramways should be so altered that the same should be adjacent to the kerb of the footway, and had amended the Bill accordingly. The Committee further thought it expedient to insert a provision that the said proposed tramways on Westminster and Blackfriars Bridges and the Victoria Embankment shall not be commenced until Blackfriars Bridge has been widened, or a new bridge has been constructed for carrying the tramways over the River Thames. The Bill authorises the London County Council to construct and work a portion of a tramway beyond the limits in respect of which they are the local authority under the Tramways Act, 1870, namely, in the City of London. This portion of tramway will connect at each end with tramways belonging to the said Council already authorised or constructed, and the Committee were of opinion that having regard to the special local circumstances such construction and working ought to be sanctioned. The total length of tramway to be constructed beyond the said limits was about 3 furlongs 4 chains. Inasmuch as Part III. (which includes Sec. 43) of the Tramways Act, 1870, is incorporated with the Bill, the Committee had not inserted any special clause for the local authority under the said Act of the district consisting of the said City in the terms of the said Sec. 43.

North-East London Railway Bill.

Thursday, June 29th.

This Bill came up for consideration by Mr. Ashton's Select Committee of the House of Commons. As our readers are aware, it is practically the same Bill as that which came before Parliament in 1903, and was then rejected.

The promoters were represented by Mr. Balfour Browne, K.C., with whom were Mr. Bushe, K.C., Mr. Page, K.C., and Mr. Macassay. The opponents were the London County Council, represented by Mr. Lewis Coward K.C., and Mr. Adkins; the Great Eastern Railway Co., counsel, Mr. Freeman, K.C., Mr. Honoratus Lloyd, K.C., and Mr. Forbes Lankester, K.C.; the promoters of the Hammersmith, City and North-East London Railway, counsel, Mr. Mr. Moon, K.C., Mr. Vesey Knox and Mr. A. Maconachie. The managers of the Bank of British North America also petitioned against the Bill.

Mr. Balfour Browne, K.C., in opening the case for the promoters, said that the line would start from the Monument, and its total length, when Waltham Abbey was reached, would be 14½ miles. It would pass through Shoreditch, Hackney, Walthamstow, and Chingford. Roughly speaking, about 4 miles of the railway, from the City to Hackney Marshes, would be in tubes of a similar size to those of the Central London Railway. The remainder would be on the surface right away to Waltham Abbey. The trains would be constructed on the multiple-unit system. Proceeding to the question of cost, learned counsel said that the average capital cost of construction worked out at £275,862 per mile of line, which compared favourably with the cost of the Central London Railway, which was £700,000 per mile. The latter railway was, of course, wholly in tube. The total estimate for land and works was £2,692,405, and the rolling stock, generating station, &c., would be provided out of the difference between that sum and the sum of £4,000,000, which was the capital proposed to be raised. £3,000,000 would be issued in shares, and the other £1,000,000 would be their borrowing powers. There could be no doubt about the urgent necessity of the line, for it was very strongly supported by the various local authorities through which it would pass.

At the conclusion of Counsel's opening statement, the Chairman of the Committee intimated that the Committee wished to hear the financial evidence as soon as possible. It will be remembered that the Bill of two years ago was rejected on the financial evidence.

Mr. Balfour Browne said that he would call the witnesses on the next day.

Sir Douglas Fox, the engineer to the scheme, was then called, and, examined by Mr. Page, said that he had had 44 years engineering experience, and had given evidence in all the tube Bills. The promoters of the present Bill were the Hon. Reginald Parker, Mr. John Henry Brixton, Mr. Edwin Wilfrid Stanyforth, Col. C. J. Lewis Stuart, and Mr. R. Foster Collinge. Resolutions in favour of the present scheme had been passed by the following local authorities:—Shoreditch, Bethnal Green, and Hackney; and also by the Urban District Councils of Leyton, Walthamstow, Chingford, and Waltham Abbey. The line was 14½ miles long, 4 miles being in tube, and the remainder in the open. It would commence at the Monument, which would be the southern terminus, and there they would have an exchange station with the Monument station of the Metropolitan District Railway, and also with the City and South London Railway. The line would then proceed under Gracechurch Street to a station, which they had now been able to agree upon without any opposition, at Gresham House. That station would be near Bishopsgate Street and Broad Street, and would consequently be in a very central position. From that point the line would proceed to Liverpool Street, where they would have subways to the station of the Great Eastern Railway, and to Broad Street station of the North London Railway. There also there would be a junction with the proposed extension of the Central London Railway. The line would proceed from Liverpool Street to the junction of the Hackney Road with the Kingsland Road, and at that point they would be able to serve the trams, which would soon be electrified. Two years ago, it was proposed to have a branch to Tottenham, but now, on account of the Great Northern and City Railway, they did not propose to do so. Furthermore, that line being wholly in tube, would have been very costly. From the Hackney Road the line would go to Victoria Park, and no objection had been made to it running under the Park. When the line reached the further side of the Park, it would emerge into the open and proceed to Leyton, Walthamstow, Chingford, and Waltham Abbey. On the way it would pass a number of cross-running tramways, which were only local lines. It was a remarkable fact that there were no really direct roads to London from those parts of the north-eastern district which the line would serve. Therefore, the line would be a great advantage, and it was proposed to make through-booking arrangements with the local lines of tramways. Witness then made the following statement regarding the estimated cost of the line:—Section No. 1 (Parliamentary estimates) will cost £195,582. That is for the works. The land is £203,847, making a total of £399,375. He had made the usual allowance for contingencies, such as the use of compressed air, of 15 per cent., as that part of the line was in tube. No. 2 would cost for works and land £324,130. No 3 was partly in tube and partly in the open, and he had divided the estimate into two parts. The first part, which was in tube, would cost £753,110 for works and £159,283 for land. The open portion, which was a much longer length (10½ miles, against the 2¾ miles of this part of the tube), would cost £526,920 for works, and £378,946 for land. The total, £912,393, for the tube part of this section, was very little more than the total, £905,866, for the open part. Section No. 4 had been dropped out, and No. 5 was a short branch, and would cost £2,992 for works, and £1,630 for land. The grand total for railway and land was £2,546,400.

Friday, June 30*th.*

Witness was cross-examined by Mr. Moon (for the Hammersmith, City and North-East London Railway promoters), who endeavoured to show that there was no necessity for the line coming into the City. Witness said that he considered that about 90 per cent. of the traffic would wish to get to the Bank, or, at any rate, to the City.

Witness was also examined by Mr. Freeman, K.C., on behalf of the Great Eastern Railway, and by Mr. Lewis Coward, K.C., for the London County Council.

Mr. D. J. Morgan, M.P. for Walthamstow, was then called and spoke in favour of the scheme.

Sir Alexander Binnie also gave engineering evidence.

Monday, July 3*rd.*

Sir Thomas Truebridge, of Messrs. Linton & Clarke, stockbrokers, of the City, was called. He said he had looked into the scheme for making the railway, and he thought it would be a financial success. There would be no difficulty in raising the £3,000,000 share capital which would be necessary for carrying out the construction of the line. Personally, he would be prepared to subscribe some £50,000, and he would, of course, recommend the line to his clients. There would be no difficulty at all about placing the debenture stock.

Cross-examined by Mr. Freeman: He was first consulted about two months ago, when he was shown a report of the scheme made by Sir Douglas Fox. He had taken a broad view of the scheme, and had come to the conclusion that it would be financially successful. He had not had any special experience of floating railway companies. When he said that he would subscribe £50,000, he meant that he would do that himself. In reply to the Chairman, witness said that he would underwrite the £50,000.

Mr. Richard B. Martin, chairman of Martin's Bank and director of a number of companies, also gave evidence of a similar character, and said that he himself would be prepared to subscribe to as well as recommend the scheme.

By Mr. Freeman: He had no particular knowledge of the district through which the line would pass. It was about a month ago when he was first consulted in the matter. He was not prepared to guarantee any of the capital of the company, but if the Bill went through satisfactorily, he would recommend it to his companies as a safe investment.

Mr. Arthur Grenfell gave similar evidence, and Mr. J. B. Braithwaite, of the firm of Foster & Braithwaite, said that his firm would take part in the distribution of the capital.

On Tuesday and Wednesday a large number of witnesses were called to prove the necessity of the line, and much of the evidence was similar to that given when the scheme was before Parliament two years ago.

(To be continued.)

The Telephone Agreement.

Continuing his evidence on June 27th, Alderman Frederick Larard, Mayor of Hull, said that he had been chairman of the Telephones Committee of the Hull City Council since it was constituted in 1899. The National Telephone Co. established an overhead system in Hull in the year 1890. In and prior to 1898 there were very numerous complaints as to the inefficiency of the service, and in answer to such complaints the company alleged that they were unable to give an efficient service with overhead wires. On February 22nd, 1898, they accordingly applied to the corporation for permission to place their wires underground so as to convert the system to an underground one. A sub-committee met the com-

pany on March 16th, 1898, with the result that the application of the company was granted on certain conditions, the agreement being terminable by the corporation on six months' notice. On March 18th, 1899, the Government brought in their Bill to give municipal corporations the power to establish telephone systems within their areas. Witness then described how on account of the introduction by the Government of the clause requiring any corporation to continue to the National Telephone Co. the wayleave already granted, the Corporation of Hull decided to give the company notice that the corporation would determine the agreement, and how the company denied the validity of the notice relating to the agreement. In November, 1899, the City Council appointed a special committee to consider and report as to the advisability of the corporation providing a municipal telephone service. After considering the matter, the committee reported favourably to the scheme. In the previous October the Postmaster-General approached the corporation with reference to a proposed extension of the Post Office telephone service in the city, and an interview, at which witness was present, took place on the 19th of that month, with the then Postmaster-General, when the position in Hull was explained by Sir James Woodhouse. The result of the interview was that the Postmaster-General said the Government would favourably consider any application from the corporation to purchase the Post Office system in case the corporation desired to establish and maintain a municipal service. Witness then described the subsequent negotiations with the Post Office, and submitted to the Committee the correspondence which took place. The corporation obtained its licence on August 8th, 1902, and thereupon engaged Mr. A. R. Bennett, M.I.E.E., as consulting engineer; with the sanction of the Local Government Board £43,292 was borrowed, and the construction of the lines commenced in January, 1904, the official opening of the exchange taking place in November of the same year. On June 15th of the present year 1,536 telephone stations had been actually connected, and 439 orders were on hand. Fresh orders were continually coming in, and it had been found necessary to extend the undertaking, and an application had accordingly been made for sanction to borrow a further sum of about £21,000. The Hull telephone area embraced about 121 sq. miles, and included the borough of Beverley and the districts of Hessle, Cottingham, and Brough. There were exchanges at each of those places. The effect of the competition in Hull had been not only to popularise the telephone to the extent shown by the business of the Corporation exchange, but also by the increase of business done by the National Telephone Co. Ninety-seven per cent. of the calls in Hull were local calls. In conclusion, witness said that in his opinion the "Agreement" was not in the public interest, (1) because its avowed object was the unification of the entire telephone system of the country in the hands of the Government; (2) because it did not prevent the National Telephone Co. charging its present high rates in non-competitive areas, and unremunerative rates in competitive areas; and (3) because it did not make it a condition of the purchase of the company's plant in 1911, that in the meantime, the company should treat alike, and without preference, all areas which were similar in size and circumstances. Other objections which he had to the "Agreement" were that it was unfair as regards the purchase of land and buildings and plant, and that it was unfair to the competing municipalities, and that the preference clause did not cover the whole of the telephone areas in the kingdom. Witness submitted to the Committee a table comparing the charges of the National Telephone Co. in Hull and those of the Hull Corporation. From this it was shown that the annual rental charged by the company for an unlimited service was £10, while the charge by the corporation for the same service was only £6 6s. The corporation's charge for an exclusive line for private houses was £5 5s., with an unlimited number of calls, whereas, although the company charged £5 for a similar exclusive line, the number of calls during the year was limited to 3,000. The corporation made no charge for installing telephones.

Name of centre.	Date of expiry of licence.	Date of opening of exchange.	No. of stations working according to last published accounts.	Gross capital expenditure.	Capital cost per station.	Annual revenue.	Annual revenue per station.	Gross annual working expenses, including interest and sinking fund.	Annual working expenses per station, including interest and sinking fund.	Last annual surplus.
Guernsey...	1911	1898	1,375	£23,590	£17 3 1	£4,546 8 9	£3 6 1½	£4,261 14 9*	£3 2 0	£284 14 0
Glasgow ...	1913	1901	11,405	£320,782†	£28 2 7	£49,639 1 2	£4 7 0½	£45,988 3 3	£4 0 7½	£3,650 17 10
Portsmouth	1926	1902	2,147	£39,240	£18 5 6	£9,366 12 8	£4 7 3	£7,393 13 5	£3 8 10½	£1,972 19 3
Brighton...	1926	1903	1,775	£45,323	£25 10 8	£6,787 16 10	£3 16 6	£6,374 2 6	£3 11 9	£413 14 4
Swansea ...	1920	1903	1,207	£20,978	£17 7 7	£3,963 8 9	£3 5 8	£2,413 14 10	£1 19 11½	£739 11 7
Hull ...	1911	1904	1,341	£30,370	£22 12 11‡	£1,261 16 11‡	...	£1,335 1 5‡	...	...
					Average.					
Totals ...	...	...	19,250	£480,283	£24 18 11	...	...	...	...	...

* Working expenses include depreciation. † Including £9,957 for preliminary expenses. ‡ Installation not complete; five months' working only.

Wednesday, June 28th.

MR. ALFRED R. BENNETT, M.I.E.E., was called. He said that he had had fully 25 years of practical telephone engineering, including the designing, estimating, constructing and maintaining of many telephone exchanges. He had held the appointments of divisional engineer to the United Telephone Co., engineer for Scotland and Ireland to the National Telephone Co., general manager and chief engineer for Scotland and the north-west of England to the same company, general manager and chief engineer to the Mutual Telephone Co., general manager and chief engineer to the Corporation of Glasgow Telephone System (from 1900 to 1904) and engineer to the telephone systems owned by the Corporations of Hull, Portsmouth, Brighton and Swansea, and the States of Guernsey. All the corporation exchanges in existence had been laid out and engineered by him. The six local authorities owning telephones whose interests were affected by the Purchase Bill, and also a conference of municipalities not owning telephones, but who feared that their interests in the future would be jeopardised, had requested him to give evidence before the Committee. Witness handed to the Committee the table given below, giving particulars of the six municipal telephone systems; he also handed in a statement showing the tariffs charged. Continuing, witness said that in constructing the municipal telephone systems efficiency had been the first consideration. The chief technical features were (1) metallic circuits everywhere; (2) underground air-space cables with twisted conductors on all main routes; (3) distribution to subscribers' premises overhead by a bronze wire (except in Glasgow, where the distribution in the centre of the city was underground); (4) hard-drawn, low-resistance copper wire on junction routes; (5) central-battery signalling (except in Guernsey and partly in Glasgow); (6) systematic protection of switch rooms and subscribers' instruments by lightning and high-voltage guards; (7) the most efficient transmitters and receivers procurable, arranged invariably in the form of hand-sets; and (8) multiple switchboards. In only one case had intercommunication been established between a municipal exchange and that of the competing company in the same area; that had been done in the case of Hull, by special agreement. In the case of Swansea, the National Telephone Co. had not hitherto been willing to allow such intercommunication to be established, and although an order was recently made by the Court of Chancery on the company to permit of and facilitate such intercommunication, up to the present time nothing had been done. Dealing with the third schedule to the purchase agreement, which contains the specification to which new work will have to conform, the witness said that he had compared it with the specification annexed to the licences of the municipalities, and found that it was very much less drastic than the latter specification. The test cable provided for in Clause 1 of the schedule was distinctly inferior to any used by the municipalities. Under the municipal licences cables up to half-a-mile radius from an exchange might not contain copper wire weighing less than 12½ lb. to the mile, while beyond a mile radius the minimum weight of the wire had to be 20·7 lb. to the mile. The test cable proposed in the purchase agreement contained copper wire weighing only 9½ lb. to the mile, and there were no limitations as to distance imposed, so that the company might put such small wire over the whole of a large town. The insulation resistance prescribed for future cables was 200 megohms per mile as measured between two wires of the same pair. The minimum insulation adopted by the corporations for completed cables was 500 megohms per mile measured with all other wires in the cable and the sheath put to earth. That was a very much more searching test; and, further, while no pressure was prescribed in the purchase specification, the municipal test was prescribed under an electrical pressure of not less than 300 volts. Under Clause 6 of the schedule the standard of speech was made equal to that obtained through 20 miles of test cable. He had no hesitation in affirming that 20 miles of the cables used by the municipalities would furnish a much higher standard, although it would be one more costly to maintain. The difference would be most marked in speaking over the Post Office trunk lines. In the municipal specification, cable junction circuits in excess of 5 miles in length must have a weight of 36·8 lb. to the mile; no provision of that kind was to be found in the purchase specification. As to Clause 2, which provided that all circuits should be free from inductive and other disturbances, and that each subscriber should be unable to hear what passed on any other than his own circuit, or those to which it was joined through, the witness thought that it was a wise provision, and the ends proposed were, he said, accomplished by the municipalities, but as far as present experience indicated, they were not realised by the London telephone system of the Post Office. In regard to Clause 4, which provided that concrete or cement blocks might be used to contain cables if they were thoroughly matured, he thought there should be some provision for ascertaining that the blocks were thoroughly

matured, as, if they were not, they would be liable to exert a most destructive effect upon the cables drawn into them. Clause 5 (1) provided that overhead distributing wires might be either open or in an overhead cable. As no specification was given, cables protected by india-rubber envelopes would be admissible, and such cables, although extensively used, had an extremely short life, and ought to be barred absolutely. There were no such restrictions in the purchase agreement with regard to the weight of overhead open wires as there were in the case of the municipalities. Clause 8 provided that on a multiple switchboard multiple jacks should be constructed on the branching system, except in cases where not more than 10 jacks were in series. On this witness remarked that under the municipal licences, branching jacks were obligatory on switchboards of all sizes, except with the special consent of the Postmaster-General, a consent which, when asked for, had not been granted. Criticising further clauses, the witness remarked with regard to 12 and 13, which dealt with the provision of lightning protectors, safety fuses, &c., that, according to his observation, the Post Office itself did not supply such devices. His opinion was that, as drawn, the purchase agreement specification was calculated to open the door to plant much inferor to that which had been installed by the municipalities. Witness, at some considerable length, then went into the question of what might be done at the various provincial towns to replace the existing plant on the lines sketched by Mr. Gavey, and dealing with the subject of cables, said that he had consulted with a leading firm of cable manufacturers, and had been informed that, with the certainty of a large demand in view, they would be prepared to lay down a great deal of extra plant so as to facilitate the output of cables. There would be no difficulty about getting ducts, as they were generally of cast-iron or earthenware, which could be manufactured quickly. He thought that there would be no need to commence duplicating plant until January 1st, 1908, and if work were commenced then very many exchanges would be in operation and earning dividends before the end of that year.

On Monday evidence was given by Sir Wollaston Knocker, the Town Clerk of Dover. Witness appeared on behalf of the Association of Municipal Corporations. He said that in May of this year the Council of the Association passed a resolution at the annual meeting referring it to the Law Committee to take any necessary action to safeguard the interests of the municipalities. That Committee, having considered the matter, passed the following resolution:—"That this Committee, while approving of the proposal of the Government to acquire the undertaking of the National Telephone Co. with a view to the early reduction of telephone charges, urges that the Postmaster-General should make all necessary provision for safeguarding the general interests of the municipalities with regard to wayleaves and to the breaking up of streets." As chairman of the meeting at which this resolution was passed, he was directed to hand a copy of it to the Select Committee.

Mr. H. E. Haward, the Comptroller to the London County Council, then went into the witness chair. He said that since 1893 the Council had given close attention to the telephone question, and had on various occasions laid its views before Committees of Parliament and the Postmaster-General. The proposed purchase of the company's system outside the London area could not fail to affect financially the interests of telephone users in that area. Witness put in a number of tables giving statistics. One of these tables compared the rate of charge for exclusive lines in the London telephone area under the agreement of 1901, and in the country under the new agreement. Other tables showed the capital of the company and the mode and price of issue; the dividends paid; prices of the company's stock; and an abstract of the company's accounts for the 3½ years to June 30th, 1904 (compiled from Garcke's "Manual of Electrical Undertakings"). Witness also put in a comparative statement of the purchase sections in the various acts. Speaking of the advantages obtained by the company and the public respectively under the agreement, Witness said that the principal gain of the company under the agreement was undoubtedly the right to be purchased in 1911. This was an enormous gain. Sir Robert Hunter had stated that the company's plant was practically worth nothing as material; its only value was *in situ*. Under the London agreement the Post Office undertook to buy such of the company's plant as was at the date of the termination of the company's licence in use by the company for the purposes of the company's London system and suitable for the actual requirements at that date of the telephonic service of the Post Office. Under the London agreement the Postmaster-General apparently had the power, subject to arbitration, to question the suitability in 1911 of any of the company's plant, whether existing at the date of the agreement or laid down subsequently. The new agreement extended the purchase in the London area to buildings, stores and furniture, which were to be purchased at their fair market value, and also to any private wire business which the company might have. The agreement did not provide specifically that no addition was to be made to the value of buildings, stores and furniture in respect of compulsory purchase, or of goodwill or of profits, and that should, in his opinion, be made clear. The purchase of the licensed telephonic business of the company which does not cease in 1911 did not directly affect London, as it did not extend beyond those cases in which the company's licence had been extended to the same period for which a municipality had been granted a licence. An important point under the new agreement was that the right of the Postmaster-General to object to plant existing at the date of the agreement did not, with a certain exception, operate outside the London area except in competitive exchange areas, although it was maintained in the London area. The private wire business of the company, of which the gross income was stated to be £120,000 a year, did not appear to be a business which it would pay the company to continue by itself after 1911, and no provision was made, so far as witness was aware, to provide that in calculating the proportion of the company's profits attributable to the private wire business, which were to be capitalised at three years' purchase, this fact should be taken into account. Sir Robert Hunter, in respect of the purchase of the company's telephonic business, the licence for which continues after 1911, pointed out that regard was to be had to the circumstances and conditions in which the company would carry on such business after 1911, and, in witness's opinion, some such provision should have been inserted in Clause 4. There was no indication whether in arriving at the "net profits" of the private wire business to be capitalised at three years' purchase, there would be deducted interest on the capital, which would be returned to the company in respect of plant, land and buildings used for such business. The company might therefore receive back their capital, which could be invested to earn interest, and also three years' purchase of so much of the net profits as represented interest on that capital. The company would in the future be able to extend its business without a large capital outlay, and the new business so obtained would, no doubt, increase the profits of the company, even after allowing for the royalty payable to the Post Office. To whatever extent the new agreement assisted the company to increase or maintain its profits it conferred a great pecuniary benefit upon the company. It was also to be noted that another advantage which the company obtained under the agreement, was that for the remainder of the term of its licence it was in effect, if not in words, freed from competition. Speaking of the advantages which the public would obtain, Mr. Haward said that the Post Office had secured that there would be no interruption of the telephone service of the country in 1911, although, as had been pointed out before, that result could have been attained by other means, perhaps less convenient, but probably no more expensive. Provisions had also been inserted in the agreement to secure intercommunication between the Post Office and company's systems, but although that advantage was greater to the Post Office subscribers owing to the greater number of the company's subscribers, nevertheless the latter, and, therefore, also the company would obtain some advantage. He gathered from the evidence given on behalf of the Post Office that the view taken had been that unless some agreement was now come to the Postmaster-General would be a forced buyer of the company's undertaking at the expiration of its licence in 1911, and that the company would be able to dictate terms. While there was some force in that contention, nevertheless it must be remembered that the company would have been in a much greater difficulty in being in possession of property useless as a going concern to anyone but the Post Office, and, moreover, the Post Office had the alternative of at once establishing a system which should between now and 1911 compete with the company, by way of either unrestricted competition or limited competition as it now prevailed in the London area, and in 1911 be ready to take over the company's subscribers.

Mr. Alpheus C. Morton, chairman of the Streets Committee of the City Corporation, was then called. He said that he was chairman of the conference of delegates of the authorities in the London telephone area in 1898, and had given evidence before the Select Committees of 1895 and 1898. He wished in the first place to deny the accuracy of Sir Robert Hunter's statement that there had been any inaction on the part of the Corporation in preventing the company from laying their underground works. As a matter of fact, the Corporation took every step in its power to prevent the company from placing their works underground. Witness then handed in copies of the various resolutions passed at the different conferences of the authorities, and said that in his opinion the object of any agreement should be to secure such a reduction in the charges for using the telephone as would ensure its most general use. The effect of the proposed agreement in that respect could not, in his judgement, be foretold with anything approaching accuracy, unless some estimate was made of the probable amount to be paid by the Postmaster-General for the undertaking. In the absence of any such estimate, and of the information upon which alone it was possible to judge of the effect of the purchase upon the charges to users, it would appear, he thought, to be most unwise that the agreement to purchase should be sanctioned.

Mr. W. E. L. Gaine gave further evidence, rebutting the statements put forward by the Corporation witnesses. With regard to the cutting of prices, he asked who began it. In every case the Corporation started by offering service at a lower rate than the company's, and it was obvious that the company had to meet this competition in the best way it could. The omnibus service introduced by the company at 25s. a year was a profitable one, and was not allowed, with less than 12 stations per line. The average number in Glasgow was 12·1, and in Hull 13·7. It was not a fact, as stated by the Mayor of Hull, that 20-party lines existed in Hull with only one subscriber each. The large development which had taken place in Glasgow was not, as alleged by Mr. Stevenson, entirely due to the competition of the Corporation; the increase had been 65 per cent. between December 31st, 1900 and 1904, and the increase throughout the whole country 58 per cent., but in places where there was no competition there had been an equal or larger increase than in Glasgow. The Corporation of Glasgow had reached the stage when replacement of obsolete plant was necessary, and had no fund to meet it. There were four different systems in use by that Corporation; their call-wire system was notoriously inefficient, and the Corporation were considering its replacement by more up-to-date plant. If the cost were charged to revenue, as it should be, they had no chance of making ends meet for years to come. The municipalities claimed that the Postmaster-General should be enabled to extend their licences and grant new ones beyond 1911 without being obliged to correspondingly extend

the company's licence. If this were done, it would be a distinct breach of a Parliamentary contract. The agreement would not affect the rates charged in Glasgow, Portsmouth or Swansea, which were fixed by the licences and were the same for both parties. In Hull it would place the company on the same minima rates as the Corporation, and in Brighton it would impose upon the company higher minima rates than the Corporation. Local intercommunication and the abolition of terminal fees could not be imposed without disturbing Parliamentary contracts. The policy advocated by Mr. Stevenson and other municipal witnesses, of leaving the areas to be developed by local authorities and the trunk wire system by the Postmaster-General, was at variance with the policy of the Government, as shown by the report of Mr. Hanbury's Committee, and was impracticable owing to the mutual jealousies of local authorities in the same area, as had been demonstrated in the Manchester area, where 33 authorities were concerned. The witness emphatically denied Mr. Stevenson's statement that no rate over £6 was necessary in the provinces. None of the municipal services was getting more than £4 10s. per station, a sum wholly insufficient to pay. The Merchants' Association of New York had investigated the telephone rates in that city, and agreed with the Telephone Co. there that net earnings of 10 per cent. on the capital invested were reasonable; the National Telephone Co.'s earnings last year were 8·11 per cent. on the net capital, after deducting the so-called water. In comparing tariffs, it was necessary to take into account the local conditions; much had been said about the Stockholm system, but he calculated that relatively the company's charges in large provincial towns were about the same as in Stockholm. As to the specification in the third schedule to the agreement, the company was entirely at issue with Mr. Bennett. He had stated that the test cable proposed contained copper wires weighing only 9½ lb. per mile; it was really 20 lb. The standard of speech over the trunk lines was based upon five miles of the test cable, not 20 miles. The witness's statement that the company paid for replacement of plant out of revenue, challenged by Mr. Bennett, was perfectly accurate. The Mayor of Hull had stated that the Corporation were induced to go into the telephone business on the faith that the policy of the Government was to develop the trunk lines and to leave the local exchanges in the hands of the local authorities; but this never was the policy of the Government. The latter also had expressly stated to the company that the renewal of a competing licence would entitle the company to a corresponding extension of their licence.

Mr. J. Gavey, engineer-in-chief to the Post Office, replying to Mr. Bennett's criticism of the specification in the 3rd schedule, stated that Mr. Bennett had erroneously taken the term "test cable" as defining the standard form of cable to be used in future underground work, and had further erred in assuming that the conductors weighed 9½ lb. per mile, instead of 20 lb. This had led to a whole series of errors in his statements. The test cable was to be used only for measuring purposes, to afford a definite measure of the efficiency of telephone intercommunication under all conceivable conditions. Innumerable experiments had been carried out on every class of conductor with a view to providing a defined and scientific method of measuring results and attaining thorough efficiency in the most economical manner possible. No doubt if the Corporations desired that the present specification should be substituted for that under which they worked, the Postmaster-General would agree to that course; but since Mr. Gavey's first interview with Mr. Bennett on the subject of the municipal specification, no suggestions had been received from the latter upon it. The insulation of the test cable had no reference to the insulation to be specified for individual cables. Speech through 20 miles of the test cable would be the same as through 20 miles of the 20-lb. cable referred to by Mr. Bennett. The results specified were the worst that would be accepted, and in certainly 80 per cent. of the cases of intercommunication a far larger volume of speech would be obtained. The objection to the use of cement blocks was based upon the supposition that they were not matured before being used; any defects due to this cause would have made themselves manifest before the purchase of the plant. The method was largely used on the Continent, for protecting lead cables. Mr. Bennett had laid considerable lengths of so-called armoured cable in the bare earth, a most undesirable practice; some cables so protected had failed rapidly when exposed to strains due to excavations for other works, and the Postmaster-General had insisted on the provision of proper protection. The question of the value of overhead cables was not a serious one. Mr. Bennett appeared to be a recent convert to the automatic signalling, as he did not provide it at Glasgow on his local service, and the witness had considerable difficulty in inducing him to provide it in connection with the trunk service. Large exchanges fitted with the common battery system were more economical than the ordinary type; small ones less so. A new design, which would render small common battery exchanges economical, had been invented, which involved the use of series jacks. Municipalities had not been refused the use of series jacks. In one instance Mr. Bennett asked to be allowed to introduce the system, and on being required to furnish particulars and reasons for the change, he withdrew his application rather than furnish the information. The statement that the new specification admitted plant inferior to that installed by the municipalities was wrong, and the same applied to his statement that if municipalities had a similar specification attached to their licences, they could have carried out their works more economically. Mr. Bennett had stated that witness's estimate per station amounted to £33, but the average number of stations was 20 per cent. greater than the average number of lines, so that for £13,250,000 he provided for 500,000 stations, at the rate of £26 10s. per station.

(To be continued.)

THE MERCURY ARC LAMP AND RECTIFIER.

Dr. E. Weintraub has contributed an article of no small interest, under the above title, to the *Electrical World and Engineer*, New York, for June 3rd, 1905, in which he describes some of the work he and others have been engaged upon in the laboratory of the General Electric Co. The article commences with some brief remarks on the history of the mercury arc lamp. From 1853 onwards patents have been granted to quite an army of investigators, who have sought to produce light by the use of mercury and the electric current. Rapieff (date not mentioned) appears to have been the first to make use of mercury vapour *in vacuo*, the arc being started by shaking the vessel. The *Ann. der Physik* for 1896 contains an extended study of the mercury arc *in vacuo*, by Arons, who determined the connection between current and potential, &c. To start the arc, Arons made use of two methods: (1) That by contact and then separation of the electrodes, and (2) that by an initial high potential. "Arons constructed a lamp which was used quite extensively by different scientists for various purposes (Gumlich, Summer, Lummer, Paschen, Le Chatelier, &c.)." As early as 1882 Jamin and Manœuvrier found that an arc could be maintained by an alternating current between a mercury and a carbon electrode, and that rectification of the current took place.

Cooper-Hewitt was apparently the next to attack the subject, and the first to prominently attempt the production of a practical lamp, by his patent of 1900 and exhibition of lamps in 1901—an attempt which has been taken up by a number of others, amongst whom is Dr. Weintraub. Cooper-Hewitt has used both of Arons' methods of starting the mercury arc, and has gone back to the contact plan as the more practicable, but Dr. Weintraub has developed a new means of striking the arc. This is based on the principle that when a small spark or arc is produced by some auxiliary means at the surface of the cathode, an emanation of conductive vapour is projected into the vessel, and upon this reaching the anode the regular arc is established. By this method the pressure of the mains, or even less, is sufficient to start the lighting. The name of side-branch lamp has been given to lamps of this type. Fig. 1 shows the lamp in its simplest form, in which K represents the negative electrode of the source of direct current; B and A are connected to the positive—A through a resistance *r*, which serves to regulate the current; B through a large resistance. By shaking or tilting the lamp, the arc K B is formed; the cathode emanations next start the arc, and the switch in the line to B is then opened. But in order to start the arc instantaneously by this simple means, certain conditions are necessary. A very high degree of vacuum is needful, which is brought about by long heating and running of the lamps on the pumps, as with ordinary incandescent lamps. The shape of the tubes must be such as to allow the free flow of cathodic ions to the anode; capillary or bent tubes hinder or prevent the starting of the main arc. Moreover, the arc does not start freely when the lamp is in a heated condition, as after use, but only when cold.

What seems, however, principally to impede the practicability of this pretty device in its simplest form, is the fact that the vacua of the lamps, although good at the commencement, become impaired with use. The introduction in some form of coco-nut carbon—so successfully used by Sir James Dewar in his low temperature work—into this lamp, to keep the vacuum sufficiently perfect, and to preserve the simplicity of construction, would be an experiment worth trial. A modification of the arrangement has, however, been devised which it would appear, renders the lighting of the lamp perfectly practicable at all times. This consists of the introduction of a carbon filament of high resistance into the tube, suspended from the anode, with the lower end not far distant from the mercury cathode. After the main arc has started, the filament carries but an insignificant amount of current. Metallic wires are inadmissible by reason of their lower resistance and fusibility.

"Fig. 2 represents such a lamp, with some additional parts, which permit the automatic formation of the side-

branch arc and the cutting out of this arc from the circuit as soon as the main arc starts. S is a solenoid, K H is an iron core enclosed in a sealed glass tube. The cut-out is at the top. On closing the switch the current flows through the contact in the magnetic cut-out, then through the coil S and the mercury surface which connects two mercury cups A and B. The magnetic action of the solenoid S lifts the iron core out of the mercury, whereby the mercury level in A is lowered, the surface E F broken and the little auxiliary arc formed. As soon as the main arc is started the action of the magnetic cut-out interrupts the auxiliary arc." Two modifications of the device with the filament are described, in one of which the filament is raised after starting the arc by contact, in the other the level of the mercury is lowered.

Some brief remarks are made on the use of the mercury arc lamp. The ordinary type is called the mono-chrome lamp. The only attempt described to introduce the much needed red and yellow rays into the mercury arc light (the lack of which constitutes the real defect of lamps of this type) is the plan, suggested by others, of running incandescent lamps in conjunction, and of blending the rays emitted by a holophane globe. The standard lamp manufactured is 16 in. long and $\frac{3}{4}$ to 1 in. in diameter, and it works on 32 volts. The anode is invariably made of artificial graphite. The lamps may be used two in series with a resistance, on 110-volt constant potential circuits, or in series on constant current circuits, or again on the direct side of a mercury arc rectifier (see below) connected on its alternating current side to a constant current transformer. The average life of the lamp is in the neigbourhood of 2,000 hours. "The efficiency goes down 15 to 20 per cent. in the first 1,000 hours, and remains afterwards nearly constant, the discoloration of the glass is the cause of this decrease of efficiency." Practical tests made with the lamps in the workshops of the General Electric Co., and in the streets of Schenectady, have given good results. In the latter case they were run on the circuit of the trolley line, with the voltage varying to such an extent that no other lamp could be used with nearly as good results.

The description of the alternating current rectifier we quote *in extenso*.

The Mercury Arc Rectifier.—1.—Principle.

The mercury arc rectifier, which, in the course of my researches, I have invented in the Research Laboratory of the General Electric Co., is founded on the principle that current flows in an arc in mercury vapours only so long as the ionisation process is going on at the cathode surface. If the ionisation process is allowed to die out, even for a very short interval of time, the current flow ceases and the ionisation process at the cathode must be started anew. If an alternating electromotive force is, therefore, to maintain a continuous arc in mercury vapours, a mercury electrode must be provided which keeps permanently its negative sign, notwithstanding the continuous change of polarity of the applied electromotive force. The two main methods that I used for this purpose are:—

First, an auxiliary direct-current arc, the cathode of which is one of the electrodes of the alternating current. Second, one or more reactances which, by their discharge in the proper direction, keep the cathode alive while the alternating E.M.F. is of the wrong polarity.

2.—The Rectifier with Auxiliary Direct Current.

In this type (fig. 3) the tube possesses three cups. A and B are connected to the alternator, and B and C to a direct-current source. Under these conditions one half wave of the alternating current passes through the rectifier in the direction A B; and the other half wave is suppressed. Combining two rectifiers of this kind allows the use of both half waves, and if Graetz's connections are used with four tubes, both half waves can be rectified and superposed in the same wire.

Another more simple way of using both half waves has, however, been devised, and is represented in fig. 4. T represents a transformer. The ends of the secondary are connected to the two anodes (we call "anode" those electrodes of the rectifier which are anodes of the rectifying arcs).

The neutral wire is connecced to the cathode. The current flows in the direction indicated by arrows and the rectified current consists of unidirectional pulsations. The auxiliary direct current, possessing the same cathode, keeps that cathode alive during the time when the current derived from the alternating source is zero or in the neighbourhood of zero. This auxiliary direct current can be made very small.

3.—The Rectifier Based on the Use of Reactances.

(*a*) *The Half-wave Rectifier* (fig. 5).—The half-wave rectifier is described first because it illustrates the principle best. The alternating E.M.F. is applied to the two electrodes, A and B. The reactance is placed between B and C. The half wave derived from the alternating current source takes the path A C D. The reactance discharges itself in the tube, producing the arc, B C, and filling out by this discharge the interval of time during which the alternating current source has the wrong polarity and cannot maintain an arc with a cathode, C. The unidirectional current flows in the wire, C E.

(*b*) *The Complete Rectifier* (fig. 6).—It is sufficient to make the above-described arrangement symmetrical by the use of two reactances to allow the rectification of both half waves and their super-position in the same wire. This arrangement is shown on fig. 6. The mode of operation of the rectifier and the working of the reactances would be clear from what I said under (*a*). This is the form of the rectifier which is used in most cases and was developed commercially.

4.—Polyphase Rectifier.

The application of the principles stated above to the rectification of polyphase currents is so obvious that I will not dwell upon it to any length. For three-phase current, three anodes are provided in the tube and reactances are inserted between the cathode and each anode respectively. The rectified current flows in the wire, connecting the cathode to the point where the three reactances are joined together.

Fig. 1.

Fig. 2.

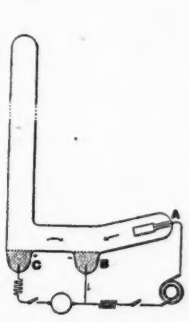


Fig. 3.

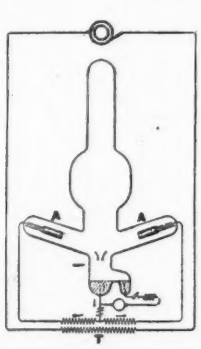


Fig. 4.

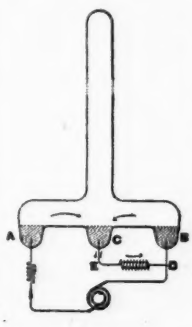


Fig. 5.

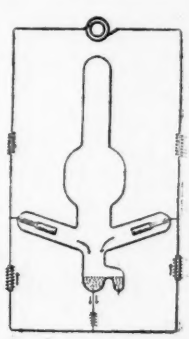


Fig. 6.

Current rectifiers constructed on this principle are no mere laboratory toys, but are being manufactured in three sizes to give 10, 20 and 30 amperes direct current respectively, and are in actual use. In the streets of Schenectady they are employed on both ordinary and mercury arc lamp circuits. Rectifiers have been constructed with a capacity of 100 amperes and over, but there are practical limits as to size beyond which it is not desirable to go. The current is led to two electrodes placed inside the arc, and there is probably a slight leakage of current between them—a leakage which increases with the voltage. Under certain conditions, of which increased voltage is one, this small discharge develops into an arc discharge. It cost Dr. Weintraub and Dr. Kruh long study and a great amount of experimental work "to differentiate the factors influencing the arcing. As a result, rectifiers are being built for as high as 25,000 volts alternating, delivering a constant current of 6·6 amperes." The efficiency of the rectifier increases as the voltage to be rectified is increased. By a judicious selection of reactances the power factor can be made to exceed 90 per cent. The rectifier is specially adapted for use in charging batteries.

In conclusion, Dr. Weintraub refers to an article he published a year ago in the *Philosophical Magazine* and to his recent paper before the American Electro-Chemical Society for further details of his researches.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

6,987A. "Improvements in electric stop-motion mechanism for looms." J. B. WHITNEY. June 23rd. (Date applied for under Patents Rule 9, April 3rd, 1905.) (Complete.)

6,987B. "Improvements in fallers for electric stop-motion mechanism for looms." J. B. WHITNEY. June 23rd. (Date applied for under Patents Rule 9, April 3rd, 1905.) (Complete.)

12,616. "Improvements in and connected with electric railways and tramways." A. SWANSON. June 19th.

12,618. "An apparatus for automatically recording the number of times a telephone is used." R. RICHMOND and G. E. CLARE. June 19th.

12,645. "Improvements in means for regulating dynamos." H. LEITNER. June 19th.

12,669. "Improvements in telephone apparatus for use for diving and like purposes." A. GRAHAM and R. H. DAVIS. June 19th.

12,690. "Improvements in intercommunication-telephone systems." I. B. BIRNBAUM and H. G. WHITE. June 19th. (Complete.)

12,725. "Improvements in arc lamps." B. M. DRAKE. June 20th.

12,778. "Improvements in electric unloaders for air compressors." H. H. LAKE. (The Ingersoll-Sergeant Drill Co., United States.) (Complete.)

12,791. "Improvements in electric locomotives." THE BRITISH THOMSON-HOUSTON Co., LTD. (The General Electric Co., United States.) June 20th.

12,792. "Improvements in and relating to dynamo-electric machines." THE ALLGEMEINE ELEKTRICITATS-GESELLSCHAFT. June 20th. (Date applied for under Patents Act, 1901, September 17th, 1904, being date of application in Germany.) (Complete.)

12,818. "An improved electric safety switch having or possessing a gas-tight sparking chamber." F. E. OLDFIELD and O. G. COWPER. June 21st.

12,822. "An electric door locking device." C. PETER. June 21st. (Complete.)

12,852. "Improvements in electro-plating." R. B. ROXBY. June 21st.

12,853. "Improvements in or connected with the electro-plating of aluminium." R. B. ROXBY. June 21st.

12,875. "Improvements in and relating to electric arc lamps." THE BRITISH THOMSON-HOUSTON Co., LTD. (The General Electric Co., United States.) June 21st. (Complete.)

12,876. "Improvements in and relating to alternating current dynamo-electric machines." THE BRITISH THOMSON-HOUSTON Co., LTD. (Allgemeine Elektricitäts.-Ges., Germany.) June 21st. (Complete.)

12,880. "Improvements in electric conductors." A. G. BETTS. June 22nd.

12,899. "Improvements in dynamo-electric generators and motors." L. K. CLARK. June 22nd.

12,945. "Improvements in dynamos for railway train lighting." H. LEITNER and R. N. LUCAS. June 22nd.

12,947. "Improvements in or relating to the storage of electrically transmitted energy." H. W. FOX. June 22nd.

12,953. "Improvements relating to safety devices for electrical apparatus." L. KOTTMAIR and R. ZWACK. June 22nd.

12,964. "Improvements in electric arc lamps." THE BRITISH THOMSON-HOUSTON Co., LTD. (The General Electric Co., United States.) June 22nd.

12,973. "An electrical timing apparatus for timing motor-cars, and for other analogous purposes." J. M. INGLIS. June 23rd.

12,976. "Improvements in the methods of and means for the distribution of electricity to street lamps and the like." G. WILKINSON. June 23rd.

12,999. "Improvements in means for ensuring the continuity of movements derived from electric energy." A. B. WEBBER and THE STANDARD TIME Co., LTD. June 23rd.

13,009. "Improvements in automatic signalling apparatus more especially for use in connection with electric traction systems." M. BYNG and W. C. C. HAWTAYNE. June 23rd.

13,025. "Improvements in electric arc lamps." W. R. RIDINGS. June 23rd.

13,062. "Improvements in or connected with insulators of electric railways, tramways and the like." R. N. TWEEDY. June 24th. (Complete.)

13,063. "Improvements in or relating to electric clock and alarm systems." W. RAUSCH and H. GONDOLF. June 24th. (Complete.)

13,073. "Improvements in telephone and telegraph relays." W. AITKEN. June 24th.

13,084. "Improvements relating to controllers for single-phase induction motors." R. P. JACKSON. June 24th. (Date applied for under Patents Act, 1901, June 30th, 1904, being date of application in United States.) (Complete.)

13,093. "Improvements in or relating to electric drills." A. J. BOULT. W. O. Duntley, United States.) June 24th. (Complete.)

13,107. "Improvements in dynamo-electric machinery." The Hon. C. A. PARSONS and A. FLINT. June 24th.

13,108. "Improvements in dynamo-electric machinery. The Hon. C. A. PARSONS. June 24th.

13,112. "Improvements in and relating to dynamo-electric machines." THE BRITISH THOMSON-HOUSTON Co., LTD. (The General Electric Co., United States.) June 24th. (Complete.)

13,113. "Improvements in holders for commutator brushes." THE MORGAN CRUCIBLE Co., LTD., and C. W. SPEIRS. June 24th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1904.

COMBINED ELECTRIC REGULATING AND MEASURING APPARATUS. E. Fauvin, E. Amiot and E. Cheneaux. (Date claimed for patent under Patents Act, 1901, November 28th, 1903, being date of application in France.) 13,483. June 14th.

ELECTRIC DRILLS. W. O. Duntley. 13,724. June 17th.

ELECTRICAL DISTRIBUTION, PARTICULARLY APPLICABLE FOR CONTROLLING ELECTRIC MOTORS. G. S. Dunn. (Date claimed for patent under Patents Act, 1901, June 18th, 1903, being date of application in U.S.A.) 13,779. June 17th.

MEANS FOR PRODUCING ELECTRIC ARCS FROM ALTERNATING CURRENTS, ALSO APPLICABLE FOR RECTIFYING ALTERNATING CURRENTS. E. Weintraub. (Date claimed for patent under Patents Act, 1901, June 20th, 1903, being date of application in U.S.) 13,908. June 20th.

LIFTS AND HOISTS. E. Chandoir. 3,356. February 10th.

HAND TELEPHONES. A. Friedlaender. 3,523. February 12th.

BRACKET FOR CARRYING ELECTRIC LIGHTING LAMPS. E. G. Taylor and R. L. Ratcliffe. 3,613. February 13th.

MANUFACTURE OF INSULATING MATERIALS. Pontite, Ltd., and S. de Pont. 3,826. February 16th.

SWITCHING SYSTEMS. G. Wright and F. V. Nicholls. 3,885. February 16th.

ELECTRIC CONNECTORS. W. C. Martin and J. Lowson. 4,110. February 18th.

CONTROLLERS FOR USE WITH CRANES, WINCHES, AND THE LIKE. The Cleveland Bridge and Engineering Co., Ltd., and C. W. Hill. 4,943. February 29th.

ELECTRIC MOTORS. Mavor & Coulson, Ltd., and H. A. Mavor. 5,926. February 10th.

ARC LAMPS. H. C. Levis. (General Electric Co., U.S.A.) 6,040, 6,041 and 6,043. March 11th.

CONTROLLING DEVICES FOR ELECTRIC MOTORS. R. A. Marples. 6,617. March 18th.

ARC LAMPS. E. A. Carolan. (General Electric Co., U.S.A.) 7,662. March 31st.

INCANDESCENT LAMPS. H. D'Olier, Jnr. 7,985. April 6th.

DEVICES FOR CATCHING AND SUPPORTING OVERHEAD ELECTRIC CABLES OR WIRES WHEN FRACTURED. H. W. D. Ingham and T. M. Jones. 8,096. April 8th.

ALTERNATING CURRENT MOTORS. The British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.) 8,399 and 8,402. April 12th.

BRUSH-HOLDERS FOR DYNAMO-ELECTRIC MACHINES. The British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.) 8,590. April 12th.

WINDINGS FOR DYNAMO-ELECTRIC MACHINES. The British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.) 8,699. April 12th.

ATTACHMENT OF GLOBES OR SHADES TO ELECTRIC LAMP FITTINGS. J. S. W. Thomas. 8,777. April 16th.

AUTOMATIC ELECTRO-MAGNETIC SANDING GEAR FOR USE ON ELECTRIC RAILWAYS AND TRAMWAYS OPERATED INSTANTANEOUSLY WITH THE ELECTRIC BRAKE FROM THE CONTROLLER HANDLE. C. W Crosbie and A. Ward. 9,427. April 25th.

CONSTRUCTION OF MOUNTING OF TROLLEY ARMS FOR COLLECTING ELECTRIC ENERGY FROM OVERHEAD CABLES FOR ELECTRIC TRACTION. E. B. Phillips and T. C. Parkin. 10,356. May 5th.

AUTOMATIC ELECTRIC CUT-OUT MECHANISM. A. P. Jones. 13,928. June 20th.

IGNITER FOR SIMULTANEOUSLY IGNITING, AND SIMULTANEOUSLY OR SUCCESSIVELY EXTINGUISHING GAS BURNERS. O. Candi and C. Candi. 20,953. September 29th.

MOTOR CONTROLLING SYSTEMS. A. C. Eastwood. 26,699. December 7th.

COUPLINGS. F. W. Sorg. 27,185. December 13th.

TRANSFORMING DIRECT CURRENT INTO MULTIPHASE ALTERNATING CURRENT. C. P. Steinmetz. 27,588. December 16th.

DYNAMO-ELECTRIC MACHINES. Phœnix Dynamo Manufacturing Co., Ltd., and R. Pohl. 28,155. December 22nd.

CONSTRUCTION AND VENTILATION OF FIELD COILS OF DYNAMO-ELECTRIC MACHINERY. Phœnix Dynamo Manufacturing Co., Ltd., and R. Pohl. 28,156. December 22nd.

ATTACHMENT FOR USE IN CONNECTION WITH SUSPENDING ELECTRIC LAMPS. E. A. J. Hooper. 28,350. December 27th.

SWITCHES. G. Harrison. (M. Guett, U.S.A.) 28,369. December 27th.

COUPLINGS FOR USE IN LAMP FITTINGS. W. F. Simmonds. 28,873. December 30th.

RAILWAY CONDUIT SYSTEMS. J. van Aerschot. 29,001. December 30th.

INSULATORS AND SUPPORTS THEREFOR. E. H. Fairbanks. 29,118. December 30th.

DYNAMOS. P. A. J. Lapeyrade. 3,337. February 10th.

ALTERNATING CURRENT DYNAMO-ELECTRIC MACHINES. M. Latour. (Date applied for under Patents Act, 1901, January 21st, 1902, being date of application in France.) 1,494. January 20th.

LIFTS AND HOISTS. E. Chandsir. 4,116. February 18th.

INCREASING THE DISCHARGE ENERGY OF ELECTRICAL VIBRATION SYSTEMS. W. P. Thompson. (Gesellschaft für drahtlose Telegraphie m.b.H., Germany.) 5,104. March 1st.

TROLLEY HEADS FOR ELECTRIC TRAMCARS. S. R. Thompson. 8,077. April 8th.

ALTERNATING CURRENT MOTORS. British Thomson-Houston Co., Ltd. (Gen. Electric Co., U.S.A.) 8,401. April 12th.

LAMP HOLDER. R. E. Rees. 8,477. April 13th.

PRIMARY GALVANIC BATTERY. P. Delafon. 8,686. April 15th.

POSITIVE ELECTRODES FOR GALVANIC BATTERIES. P. Delafon. 8,984. April 16th.

DYNAMO-ELECTRIC MACHINES. The British Thomson-Houston Co., Ltd. (The Gen. Electric Co., U.S.A.) 9,117. April 20th.

ARMATURES FOR DYNAMO-ELECTRIC MACHINES. A. F. Hills, D. Urquhart and A. E. Honey. 9,372. April 23rd.

TRAMWAY OR RAILWAY VEHICLES. J. S. Raworth. 9,565. April 26th.

TRANSMISSION OF SOUND TO LONG DISTANCES AND TELEPHONIC APPARATUS THEREFOR. V. Tardieu. 11,262. May 16th.

TUMBLER AND LIKE SWITCHES. M. Lawton and H. N. Whatson. 11,777. May 24th.

ELECTRIC LIGHT FITTINGS. H. Lea. 13,169. June 10th.

SWITCHES PARTICULARLY ADAPTED FOR USE WITH TARGETS. C. Chevallier and E. Cadet. (Date applied for under Patents Act, 1901, August 14th, 1903, being date of application in France.) 15,332. July 8th.

TROLLEYS FOR ELECTRIC TRACTION. J. Lauvernier. 17,939. August 18th.

ELECTRIC LIGHT FITTINGS. H. Lea and S. Mitchell. 19,242. September 6th.

CONTROLLERS FOR ELECTRIC CURRENT. P. M. Justice. 22,326A. October 17th.

ARC LAMP ELECTRODES. Körting and Mathieson Actien-gesellschaft. (Date applied for under Patents Act, 1901, October 31st, 1903, being date of application in Germany.) 22,342. October 17th.

SCRAPER FOR ELECTRO-MAGNETIC SEPARATOR. E. H. Geist, (Date applied for under Patents Act, 1901, January 18th, 1904, being date of application in France.) 22,813. October 22nd.

ELECTRIC BRAKES R. B. Ransford. (The American Elec. Brake Co., U.S.A.) 24,675. November 14th.

ELECTRIC ARC LAMP. W. Fairweather. (The Marquette Elec. Co., U.S.A.) 28,409. December 27th.

INSULATORS AND PROTECTIVE DEVICES FOR OVERHEAD ELECTRIC CONDUCTORS. E. Giraud. (Date applied for under Patents Act, 1901, May 2nd, 1904, being date of aplication in France.) 29,063. December 30th.

SAFETY DEVICES FOR OVERHEAD ELECTRIC CONDUCTORS. E. Giraud. (Date applied for under Patents Act, 1901, April 14th, 1904, being date of application in France.) 29,064. December 30th.

ELECTRIC FIXTURES. H. H. Lake. (W. Lincoln, Bradshaw, A. Keough, M. Keough and J. Keough, U.S.A.) 29,397. December 31st.

CIRCUIT CLOSER FOR FIRE ALARMS. J. E. Bemiller and E. C. Weisendale. 29,538. December 31st.

FORM OF CARBON SPECIALLY SUITABLE FOR FILAMENTS OF ELECTRIC INCANDESCENT LAMPS AND THE MANUFACTURE THEREOF. H. C. Levis. General Electric Co. (Date applied for under Patents, Rule 9, March 22nd, 1904.) 6,959A. March 22nd.

SAFETY DEVICE FOR OVERHEAD ELECTRIC CONDUCTORS. F. W. Hayward and R. C. Fox. 11,884. May 25th.

ROTARY ELECTRIC SWITCH. John Dugdill. 11,887. May 25th.

ALTERNATING CURRENT ELECTRIC METERS. Allgemeine Elektricitäts Ges. (Date applied for under International Convention, June 2nd, 1903.) 12,545. June 2nd.

ELECTRICALLY-PROPELLED RAILWAY AND TRAMWAY VEHICLES. R. J. C. Collins. 13,353. June 13th.

CONTROLLING SWITCHES FOR ELECTRIC CIRCUITS. British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.) 13,570. June 15th.

APPARATUS EMPLOYED FOR MEASURING WAVE LENGTHS IN WIRELESS TELEGRAPHY. J. A. Fleming. 13,736. June 17th.

SELF-LOCKING ELECTRIC CONTACT-MAKER OR SWITCH FOR FIRE ALARM AND OTHER PURPOSES. J. H. Golding. 14,111. June 22nd.